4.0 Environmental Consequences

This section presents an analysis of direct and indirect impacts of the regulatory alternatives under consideration. Direct impacts are those localized and immediate in their effect (e.g., sedimentation within surface water runoff). In contrast, indirect impacts are those that may affect those same resources, but would be evident somewhat later in time or somewhat removed in distance from the primary areas of operation, but are still reasonably foreseeable (e.g., the effect of a change in watershed on wetlands).

This section also integrates the assessment of cumulative impacts as required by 40 CFR 1508.7 and ER 200-2-2. A cumulative impact analysis must consider the potential impact on the environment that may result from the incremental impact of the project when added to other past, present, and reasonably foreseeable future actions. While the consideration of cumulative effects is normally presented in a separate section of an EIS, it is organizationally incorporated here into the assessment of the effects of the primary action. This approach will allow a more thorough and integrated analysis of environmental impacts of the primary action (which is procedural in nature) with those of specific development projects within the floodplain that may impact the resources subject to USACE regulatory authority.

The methodology for performing such analyses is set forth in “Considering Cumulative Effects Under the NEPA” [Council on Environmental Quality (CEQ), 1997] and includes the following:

1. Identification of the area in which effects of the project may be felt;
2. Assessment of the impacts that are expected in that area from the project;
3. Identification of other actions (past, present, and reasonably foreseeable) that have had or are expected to have impacts in the same area;
4. Assessment of the impacts or expected impacts from these other actions; and
5. Assessment of the overall impact that can be expected if the individual impacts are allowed to accumulate.

For this project, the geographic area of analysis for evaluation of cumulative impacts is the Howard Bend floodplain as discussed in Section 1.0. Other actions that will be considered as part of this analysis are presented and described in Section 2.0. In most cases, the consideration of other past actions and their associated impacts were limited to those occurring subsequent to 1985 (the time at which the current USACE regulatory program became effective). However, in the case of some natural resources (i.e., land cover, wetlands, surface water), the cumulative impact analysis entailed a more extensive historical analysis to establish the long-term trends of these resources within the study area (see Sections 4.6.2, 4.7, and 4.8.1, respectively). With respect to reasonably foreseeable future actions, those considered are limited to projects that have been identified for the study area and those that have demonstrated some level of commitment by the project proponent (e.g., approved plan, commitments to mitigative measures, financial commitments to the project, expenditure of effort for preliminary designs, etc.).

4.1 Social/Economic Characteristics and Land Use

4.1.1 Demographics

Changes in population characteristics for the study area are evaluated in terms of both direct and indirect effects (Table 4-1). Direct impacts to populations are those attributable to changes in residential population, as well as the influx of workers into the study area that may be

required to construct a given development project or facility. In contrast, indirect demographic impacts may be thought of as those associated with subsequent changes in the level of employment within the study area as a result of the operation of a given facility.

Table 4-1. Summary of Impacts to Demographic Characteristics Associated with Past, Present and Reasonably Foreseeable Future Actions

Action	Impact to Demographics
Primary Action	
Alternative 1: Case-by-Case (No Action)	No impacts
Alternative 2: SAMP	No impacts
Past Actions	Three residential displacements, and three commercial displacements due to Page Avenue Extension mitigation*
Present Actions	No impacts
Reasonably Foreseeable Future Actions:	
1. Flank Levee System	
Alternative A	No impacts
Alternative B	No impacts
2. MHE Extension (Alternatives 1-5)	Number of homes displaced: 1-14† Number of residents displaced: 2.5-35†
3. Baxter Road Extension	
Options 1-2	No impacts
4. Relocated Hog Hollow Road	No impacts
5. MSD Plant Expansion	No impacts
6. Land Use Plan Development	
Scenario 1: Interim Condition	12 residential displacements (assumes total build out)
Scenario 2: Ultimate Condition	12 residential displacements (assumes total build out)
7. Terra Vista Estates	Number of new residential units: 32 Approximate number of new residents: 80
8. Mill Ridge Villas	Number of homes displaced: 2 Number of new residential units: 46 Approximate number of new residents: 115
9. Creve Coeur Lake Dredging	No impacts
Subtotal	
Total	

* Booker, 1992.

† Numbers are preliminary and are based upon conceptual alternates only. Range of residents potentially displaced is based upon an average household size of 2.5 (Missouri Census Data Center, 2000).

4.1.1.1 Past and Present Actions

Past actions have had little direct impact on the demographic composition of the study area. Past actions considered in this cumulative impact analysis have resulted in three residential and three commercial displacements in conjunction with the Page Avenue Extension mitigation. No appreciable impact on population was observed as a result of these actions. These past actions have, however, had an effect on the transient, day (non-residential) population in that the development of Sportport, Riverport, and Harrah's Casino complex significantly increased the non-residential, day population.

As with past actions, present actions have not affected the demographic characteristics of the residential population in the study area. No residential displacements or additions have occurred

as a result of the present actions. The construction of the Howard Bend Levee will afford increased flood protection to persons who already live and work in the study area as well as those non-residents who utilize the services and facilities in the study area. Construction-phase activities for each of the present actions have resulted in an influx of workers using the area.

4.1.1.2 Future Actions

With the exception of the Terra Vista Estates subdivision and the Mill Ridge Villas development, none of the reasonably foreseeable actions will directly impact the demographic composition within the study area. If both of these developments are constructed, there will be an additional 78 homes in the study area north of Olive Boulevard which may result in a corresponding residential increase of approximately 195 persons [based upon an average household size in the City of Chesterfield of 2.5 (Missouri Census Data Center, 2000)]. The completion of the Mill Ridge Villas development will result in the displacement of two homes. This increase of 0.17 percent within the City of Chesterfield does not represent a significant change in the City of Chesterfield's population.

Although the construction of the Howard Bend flank levee system for Creve Coeur and Fee Fee creeks will not directly alter the demographic composition within the study area, it will result in improved stormwater management which will aid increased development in general. This improved stormwater management, in conjunction with the City of Maryland Heights' Future Land Use Plan and the expansion of the MSD plant, will likely result in an increase in the number of daytime persons who either work in the study area or utilize its services and facilities.

The extension of the MHE south to Olive Boulevard is an action that may have a minor adverse impact on local residential areas. Depending on the option that is selected, up to 14 existing residences may be displaced (approximately 35 existing residents). [Note: The MHE Extension has not yet been designed and the number of residential displacements is conceptual only.] This accounts for 0.07 percent of the population of the City of Chesterfield and does not represent a significant change in the local demographics.

Additionally, two planned residential developments are also located in the Creve Coeur Creek valley north of Olive Boulevard, and if constructed, could be adversely affected by one or more potential MHE extension alternatives. Depending on the extent to which these developments are constructed and the final alignment of the future MHE extension, additional residential units may be displaced.

4.1.1.3 Regulatory Action

Neither of the two regulatory alternatives (No Action and implementing a SAMP) would impact the demographic composition in the study area either directly or indirectly.

4.1.2 Environmental Justice

Potential disproportionate impacts to low income and minority populations were evaluated in accordance with Executive Order 12898. The City of Maryland Heights contains a population that is comprised of 85.4 percent white residents, 5.6 percent black residents, and 8 percent residents of other races (see Table 3-3). In addition, the residents of the City of Maryland Heights had a median household income in the year 2000 that was only 3.7 percent lower than the median household income in St. Louis County and was 22 percent higher than the median household income in the State of Missouri (see Table 3-5). No disproportionately high or adverse human health or environmental effects are expected to occur to low income or minority groups with either of the regulatory actions or any of the reasonably foreseeable future actions.

4.1.3 Economic Characteristics

No detailed analysis was made to quantify the economic impacts of the actions under consideration in this EIS. However, some generalizations can be made to acknowledge the effects of past, present, and reasonably foreseeable future actions on the economic characteristics of the study area. An assessment of the potential economic impacts from past, present, and future foreseeable projects will be most appropriately focused on both the direct and indirect effects of the particular project. Direct economic impacts include changes to the employment base and the increased personal income of workers during the construction and operational phases of each of the projects under consideration. Due to the greater proportion of the study area that falls within the City of Maryland Heights, the City of Maryland Heights' tax base will experience a much greater impact than the tax base in the City of Chesterfield.

4.1.3.1 Employment

Past actions have directly shifted the employment characteristics within the study area from primarily agricultural to commercial, hospitality, and service-related employment. Temporary employment is provided during the construction phase for all actions, whereas additional jobs are created in association with any developed facilities. For example, past and on-going development in the Riverport/Harrah's planning district has resulted in the creation of approximately 11,500 jobs. This shift is expected to continue with future actions in accordance with changes in developed land use. Other employers in the Howard Bend area are not accounted for in this number and would include water and wastewater treatment operations, the Creve Coeur Airport, and smaller employers located throughout the study area.

Among the reasonably foreseeable future actions, future land development in accordance with the City of Maryland Heights' Future Land Use Plan would result in a significant change in local employment. A precise estimate of additional employment is not possible, as future development will be market-driven. However, based on the permissible uses identified in the City of Maryland Heights' Future Land Use Plan, it is estimated that such development may support (upon complete build out) between 25,000 and 35,000 full time and part-time jobs in addition to the 11,500 identified at the Riverport/Harrah's district. The rate at which these changes may be expected to occur, however, can not be predicted, as future development within the study area will be market driven. For each action, the investment of capital (and the employment of workers) to develop and operate the facility (i.e., roadway, plant expansion, commercial development, entertainment venue) results in a multiplier effect within the local and regional economy. This effect, while not quantified, produces additional economic benefits due to multiplier effects that include increased sales revenues of supplies, increased employment, additional housing requirements, and expansion of the tax base (Regional Multipliers, 1992).

4.1.3.2 Tax Base

Past and present actions have had a variable effect on the local tax base. Actions taken by public or semi-public entities such as MoDOT, the Missouri American Water Company, and the City of Maryland Heights have required the acquisition of lands that had previously been taxable (predominantly agricultural land). The conversion of these lands to public ownership has resulted in some reduction in the tax base. In contrast, commercial and entertainment-based developments such as Riverport and Harrah's Casino complex have resulted in an increase in property value of lands contained within their levee (or flood protection berm). Similarly, these developments have provided a considerable expansion of the tax base (real estate taxes, casino revenue) over that assessed for agricultural uses.

The on-going construction of the 500-year primary levee has also had the effect of increasing property value. Improvements in stormwater management and improved traffic patterns within the study area will facilitate increased development within the study area (i.e., in accordance with the City of Maryland Heights' Future Land Use Plan). This increased development will result in increased tax revenues to the HBLD, St. Louis County, and the City of Maryland Heights. The Terra Vista Estates subdivision and Mill Ridge Villas, if constructed, would also generate additional tax revenue. The dredging of Creve Coeur Lake and the expansion of the MSD plant will not have an effect on the local tax base. Each action will be conducted entirely within publicly owned lands.

There will be no effect on economic characteristics from the adoption of a SAMP versus No Action with regard to regulatory oversight within the study area.

4.1.4 Land Use

4.1.4.1 Past and Present Actions

Prior to 1985, land use in the Howard Bend study area consisted primarily of agricultural areas (row crop production), open space, utility companies (MSD, St. Louis City and County Water), and recreational lands (CCLMP). Since 1985, changes in land use within the study area resulted from the development of Riverport, Harrah's Casino complex, and Sportport which converted primarily agricultural land to commercial, arts and entertainment, and parks and recreation, respectively. Additional changes in land use have occurred due to the development or expansion of existing transportation facilities (e.g., Page Avenue Extension, MHE, and trails around CCLMP, etc.) (see Section 3.1.3) or recreational facilities (e.g., Crystal Springs Quarry Golf Club). Additionally, the construction of a portion of the 500-year levee required the acquisition and displacement of the Chesterfield Golf Course for realignment of the levee out of the floodway and for the acquisition of fill material. However, as presented in Table 3-9, agricultural lands still represent, by far, the prominent land use (approximately 45 percent or 3,907 acres), followed by parks and recreation (approximately 23 percent or 1,960 acres).

4.1.4.2 Future Actions

Future development of unconstrained lands in accordance with the City of Maryland Heights' Future Land Use Plan will generally conform to the "Encouraged" and "Conditional" uses within each Planning District as discussed in Section 2.2.5. The specific nature and type of development within each Planning District cannot be known at this time as this future development will be market-driven. With few exceptions, future actions will have the greatest impact on agricultural lands (Table 4-2). Future development will impact approximately 1,658 acres of existing agricultural land. The same amount of land will be impacted under either the interim (Scenario 1) or the ultimate condition (Scenario 2); however, the rate at which the build-out occurs differs between the two conditions. Development of the flank levee system will impact between 132 and 166 acres of agricultural lands. Options 1 and 2 of the Baxter Road extension will impact between 21 and 23 acres of agricultural lands. Impacts from the MHE Extension to Olive Boulevard and the relocation of Hog Hollow Road are both nominal (i.e., less than 1 acre per project). In the case of the MHE, future extension of this roadway will occur within a corridor previously dedicated to transportation uses (see Figure 2-6). There will be no impacts to agricultural lands from any other reasonably foreseeable future actions. Collectively, all reasonably foreseeable future actions will impact between 1,812 and 1,848, or approximately 47 percent of existing agricultural land.

Table 4-2. Summary of Potential Impacts to Land Use Associated with Foreseeable Future Actions

Action	Category									
	Accommodation/ Hospitality	Agriculture	Arts and Entertainment	Commercial	Industrial	Parks and Recreation	Residential	Utility and Public Service	Vacant	Transportation
1. Flank Levee System										
Alternative A	0	131.7	0	2.7	0	0	0	4.1	26.3	3.0
Alternative B	0	166.0	0	4.8	0	0	0	12.9	38.5	6.4
2. MHE (Options 1-5)	0	0.7-0.7	0	0.8-1	0	0	0	0.2-2.1	8.5-13.6	18.1-20.1
3. Baxter Road Extension (Options 1-2)	0	20.7-23.1	0	0-0.3	0	2.5-5.4	0	11.4	7.1-10.1	0.4-3.5
4. Hog Hollow Road Relocation	0	0.7	0	1.2	0	0	0	1.1	1.07	0.1
5. MSD Plant Expansion	0	0	0	0	0	0	0	43.8	0	0
6. Land Use Plan Development										
Scenario 1: Interim Condition	0	1,657.9	0.00	100.6	0.8	66.7	13.1	9.8	208.5	38.5
Scenario 2: Ultimate Condition	0	1,657.9	0.00	100.6	0.8	66.7	13.1	9.8	208.5	38.5
7. Terra Vista Estates	0	0	0	0	0	0	0	0	7.3	0
8. Mill Ridge Villas	0	0	0	0	0	0	5.2	0	12.1	2.8
9. Creve Coeur Lake Dredging	0	0	0	0	0	95.7	0	0	0	0
Total	0	1,811.7-1,848.4	0.00	105.3-107.9	0.8	164.9-167.8	18.3	70.4-81.1	270.9-291.2	62.9-71.4

As discussed in Section 3.1.3, parks and recreation areas comprise the second largest percentage of land in the study area (approximately 23 percent). The planned dredging of Creve Coeur Lake will impact the largest portion of parks and recreation areas (approximately 96 acres for spoil disposal). The dredged material disposal site located south of Page Avenue and west of Creve Coeur Mill Road will directly affect 41 acres of dedicated 6(f) lands within CCLMP. Future land development will impact approximately 67 acres of park and recreation land. Future transportation projects will also impact park and recreation lands. The Baxter Road Extension will directly affect between 3 and 5 acres of dedicated 6(f) lands within CCLMP. Additionally, as discussed in Section 4.1.6, depending on the location of the final alignment, the Baxter Road Extension may also result in the creation of a 66-acre remnant of 6(f) lands to the south of Baxter Road. A total of between 151 and 154 acres (or approximately 8 percent) of park and recreation land will be impacted by reasonably foreseeable future actions.

The next highest range of impacts of future projects will be to vacant land, which comprises approximately 10 percent of the study area. As was the case with agricultural land, the greatest impact to vacant land will be as a result of future development of unconstrained lands (208 acres). Development of the flank levee system will impact between 26 and 38 acres of vacant land, and the three future transportation projects (the MHE Extension, the Baxter Road Extension, and the relocation of Hog Hollow Road) all impact less than 14 acres of vacant land per project (see Table 4-2). Terra Vista Estates and Mill Ridge Villas will convert between 7 and 12 acres of vacant land (respectively) to residential uses. In total the reasonably foreseeable future actions will impact between 271 and 291 acres of vacant land.

Land dedicated to commercial usage currently accounts for approximately 569 acres (or approximately 7 percent of the study area). Commercial areas are located in Riverport development, Creve Coeur Airport (which is considered a commercial-transportation facility) and in the southeastern portion of the study area (in Chesterfield just north of Olive Boulevard) (see Figure 3-1). The greatest impact to commercial land will be from the future development, which will impact approximately 101 acres. The flank levee system will impact between 2 to 5 acres.

Utility and public services consist of the MSD treatment plant and St. Louis City and County water plants (see Figure 3-1). Expansion of the MSD plant will have the greatest impact, as the plant is categorized as a utility facility. Approximately 44 acres will be impacted by the plant's expansion. The flank levee system will impact between 4 and 13 acres of utility and public service land. The Baxter Road Extension and the relocation of Hog Hollow Road will impact approximately 11 acres and 1 acre of utility and public service land, respectively. Potential future development may also impact approximately 10 acres of utility and public service land.

4.1.4.3 Regulatory Actions

Neither the No Action (Case-by-Case Permitting) nor the SAMP alternative will have a direct effect on land use alteration within the study area. Guidelines and restrictions on future development under the SAMP alternative will, however, contribute to the specific features of future development including the degree of preservation of natural habitats, mitigation requirements (including the establishment of one or more wetland banks within the study area) and the need for protective vegetated buffers.

4.1.5 Public Services and Facilities

4.1.5.1 Past Projects

Transportation improvements such as the Page Avenue Extension will result in improved access for emergency vehicles traveling in and around the study area, and will improve the level

of service provided to those living and working in the study area. (The expansion of Creve Coeur Airport had no significant effect on public services and facilities.) Developments such as Riverport, Harrah's Casino complex, and Sportport have increased the number of daytime non-residents who work in the study area or who use facilities or services within the study area. This increased daytime population results in a greater demand for public services and facilities. Revenue generated by Harrah's Casino complex is used in part, to provide improved public services and facilities within the study area. Indirectly, tax revenues from other developments within the study area are also used to provide public services. The expansion of the Missouri American Water Company's Central Plant provided an increased ability to meet the growing demand for potable water.

4.1.5.2 Present Projects

Improvements in the efficiency of the transportation infrastructure (i.e., the MHE Extension to River Valley Drive) will have the effect of increasing response times of emergency vehicles, and will improve access to recreational and entertainment facilities. The construction of the Howard Bend Levee has no direct effect upon public services and facilities. However, the improved protection provided by the 500-year levee will allow for the maintenance of services and continued access to facilities under flood conditions.

4.1.5.3 Reasonably Foreseeable Future Projects

As with past and present transportation improvements, the eventual extension of the MHE south to Olive Boulevard and completion of the Baxter Road Extension will generally not directly affect public facilities, but will result in improved emergency services' response time and will enhance access to recreational and entertainment facilities within the study area. Several of the potential alternatives to the future MHE extension, however, would result in the displacement of the First Baptist Church of Creve Coeur.

In contrast, future developments within the study area (i.e., Terra Vista Estates subdivision, Mill Ridge Villas, and development in accordance with the City of Maryland Heights' Future Land Use Plan) will result in an increase in the number of persons and employment centers in the study area, thus resulting in a greater demand upon public services and facilities. Construction of the Howard Bend flank levee system for Creve Coeur, Fee Fee and Louiselle creeks and the dredging of Creve Coeur Lake will have no direct affect on public services and facilities. The existing MSD plant which treats wastewater for the region is currently at capacity and is a factor that is limiting future development. The planned expansion of the MSD plant will result in an improvement in the capacity to provide wastewater treatment, but may facilitate future demands for such services by additional developments.

4.1.5.4 Regulatory Alternatives

Neither the SAMP nor the No Action (Case-by-Case Permitting) regulatory alternative will have a significant effect on public services and facilities.

4.1.6 4(f)/6(f) Lands

4.1.6.1 Past and Present Actions

Potential impacts of past and present actions on 4(f)/6(f) lands have consisted of the crossing of CCLMP by the Page Avenue Extension project. This project resulted in significant impacts on the park as it crossed the upper end of Creve Coeur Lake. As compensation for those impacts,

MoDOT purchased and donated a total of 1,102 acres of land to the CCLMP for future recreational uses (see Section 3.1.5).

4.1.6.2 Future Actions

With the exception of the Baxter Road Extension and the future extension of the MHE, none of the reasonably foreseeable future actions are expected to result in impacts to 4(f) or 6(f) lands. Baxter Road Extension, depending on its alignment, may result in both direct and indirect impacts to the dedicated 6(f) lands within CCLMP. The future extension of the roadway to a connection with the MHE Extension may require a more northerly alignment (see Figure 2-8) that would entail the direct conversion of approximately 5.4 acres of 6(f) lands. By comparison, a southerly alignment along Waterworks Road would encroach upon 2.5 acres of 6(f) lands. This southerly alignment, however, may not allow for an effective connection with the future MHE as the MHE will be on structure at this location. Indirect impacts, ranging up to 66 acres may also result from the severance of the 6(f) lands in association with a northerly alignment of this roadway. The resultant effect of this severance will be a reduced utility of the 66-acre 6(f) remnant and inefficient management of the area.

The future MHE Extension will extend through 6(f) lands along a reserved transportation corridor. The potential indirect impacts of this future corridor with regard to noise and visual impacts were, however, recognized by the NPS (NPS, 1995a). As a result, a corridor width was established at 660 feet to allow for the natural mitigation of noise over distance, and to allow for some reduction in the visual impact.

4.1.6.3 Regulatory Actions

Neither the No Action (Case-by-Case Permitting) nor the SAMP alternative will have an effect on 4(f) or 6(f) lands.

4.2 Cultural Resources

4.2.1 Past and Present Actions

Several previously recorded archaeological sites have been affected by past (i.e., since 1985) and present actions. These included one prehistoric site and three historic sites affected by the Riverport development. None of these sites, however, were either listed or determined to be eligible for listing to the NRHP. One historic site (farmstead) that had not been formally evaluated as to NRHP eligibility was impacted by the Page Avenue Extension and again by the MHE Extension to River Valley Drive. Consequently, none of the past or present actions have significantly affected cultural resources.

4.2.2 Future Actions

None of the foreseeable future actions identified will impact archaeological or architectural sites either listed or determined to be eligible for listing to the NRHP. Several sites, however, have been identified that have not been formally evaluated, but may be impacted by future actions. Specifically, each of the flank levee alternatives may affect two historic sites; the MHE may affect two historic sites and one prehistoric site; the Mill Ridge Villas development may affect a potentially historic limestone quarry (minor impact due to detention basin); and future land use development may affect one historic site (Table 4-3). Additionally, the ultimate future development of the floodplain may further impact the Dussault Farm, a site determined to be potentially NRHP eligible (ARG, 2002).

Table 4-3. Summary of Impacts to Cultural Resources Associated with Past, Present and Reasonably Foreseeable Future Actions

Action	Archaeological Resources	Architectural Resources
Primary Action		
Alternative 1: Case by Case Permitting (No Action)	No impacts	No impacts
Alternative 2: SAMP	No impacts	No impacts
Past Actions	One historic site not evaluated for NRHP eligibility (#23SL741)	
Present Actions	One historic site not evaluated for NRHP eligibility (#23SL741)	No Impacts
Reasonably Foreseeable Future Actions		
1. Flank Levee System		
Alternative A	Two historic sites not evaluated for NRHP eligibility (#23SL739, and #23SL740)	No impacts
Alternative B	Two historic sites not evaluated for NRHP eligibility (#23SL739, and #23SL740)	No impacts
2. MHE (Options 1-4)	Three sites not evaluated for NRHP eligibility: ▪ 1 prehistoric (#23SL734) ▪ 2 historic (#23SL737, #23SL742)	No impacts
3. Baxter Road Extension (Options 1-2)	No impacts	No impacts
4. Hog Hollow Road Relocation	No impacts	No impacts
5. MSD Plant Expansion	No impacts	No impacts
6. Land Use Plan Development		
Scenario 1: Interim Condition	Impacts to one site not evaluated for NRHP eligibility (23SL741)	Impacts to site # 1, Dussault Farm
Scenario 2: Ultimate Condition	Impacts to one site not evaluated for NRHP eligibility (23SL741)	Impacts to site # 1, Dussault Farm
7. Terra Vista Estates	No impacts	No impacts
8. Mill Ridge Villas	Encroachment on one historic site not evaluated for NRHP eligibility.	No impacts
9. Creve Coeur Lake Dredging	No impacts	No impacts

4.2.3 Regulatory Actions

There will be no direct impacts to archaeological resources as a result of regulatory actions under Case-by-Case Permitting or under the provisions of a SAMP. As is the current policy of the USACE, review of potential future actions requiring a Section 404 permit shall include a consideration of cultural resources. Coordination will be conducted with the Missouri State Historic Preservation Office of the MDNR in accordance with Section 106 of the National Historic Preservation Act.

4.3 Traffic and Transportation

Significant modifications in the traffic network and associated roadway system have occurred since 1985 in the northern sections of the study area, and major future changes in the roadway network are being constructed or planned. These improvements, both built or planned, are in response to new development, significant changes in the regional transportation network, and future planned development. In addition to the roadway improvements within the study area, past and future improvements are proposed for the Creve Coeur Airport facilities and runways and the trail system of CCLMP.

4.3.1 Past and Present Actions

Major roadway improvements in the study area since 1985 included improvements to Earth City Expressway from I-70 to Pritchard Farm Road, development of the Casino Drive access road to the Harrah's Casino complex, and major intersection improvements at both of the Riverport Drive intersections with Earth City Expressway.

With the initial development of the Riverport development in 1987, lane widening of Earth City Expressway south of I-70 took place in anticipation of the increased traffic to serve the development. To improve levels of service of the Riverport Drive intersections at Earth City Expressway, significant intersection improvements were conducted in 2002 and 2003 at both the north and south intersections with additional lane widening to Earth City Expressway.

The development of Harrah's Casino complex in 1996 required a major access road to the gaming facility and its associated parking and service drives. Casino Drive, approximately 1 mile in length, is an access road developed on top of a flood protection berm. Riverport and Harrah's Casino complex are restricted on the amount of build out that they will ultimately be permitted based upon the level of service that their intersecting roadways have with Earth City Expressway.

Present actions associated with the study area roadway network are significant and are in response to major improvements within the regional transportation system and anticipation of future development. The primary improvement is the construction of the Page Avenue Extension. This 10-lane facility connects St. Charles County and St. Louis County with a new crossing of the Missouri River. The Page Avenue Extension connects Route 94 in St. Charles County with I-270 in St. Louis County. In the Howard Bend study area, one access point to Page Avenue is available. This access point is south of River Valley Drive and will be accessed via a diamond interchange with MHE.

The new MHE improvement is a four-lane expressway facility expandable to six lanes from the intersection of Pritchard Farm Road with Earth City Expressway south to River Valley Drive. The improvement includes two bridges. The first bridge is 550 feet in length over Fee Fee Creek, and the second bridge is 100 feet in length over Creve Coeur Creek.

South of River Valley Drive, the MHE is constructed as two through lanes to the Page Avenue Extension interchange with associated left turn lanes to and from the ramps of Page Avenue Extension. Other ancillary improvements with the MHE include:

- Reconstruction of the intersection of Pritchard Farm Road and Casino Drive with MHE;
- Extension of Marine Avenue with intersection improvements with MHE;
- New intersection improvement of MSD Drive with the MHE;
- Closure of access from Creve Coeur Mill Road to River Valley Drive; and
- Improvements to Airport Road alignment and intersection with MHE.

These improvements are consequences of the MHE improvement and are designed to improve circulation and reduce intersection congestion and conflicts once the MHE and Page Avenue Extension are operational.

Traffic modeling and forecasting of these conditions were developed for 2003 in anticipation of these improvements becoming operational (Table 4-4). These forecasts for future AADT levels are based upon certain assumptions on how these improvements will react to the attractiveness of both regional and local trips to the new facilities in 2003.

Table 4-4. Forecasted AADT with MHE from Earth City Expressway to Page Avenue Extension (2003)

Roadway and Segment	AADT (2000)
Page Avenue Extension (at Missouri River)	30,000
MHE (north of Page, two-lane section)	7,500
MHE (north of River Valley, four-lane section)	6,000
MHE (north of Marine)	15,000
Earth City Expressway (north of Pritchard Farm)	28,500
Creve Coeur Mill Road (north of Page Avenue Extension	10,500
Marine Avenue (at Creve Coeur Mill Road)	6,500

* Forecast assumes four-lane connection of MHE from Earth City Expressway to River Valley Drive and two-lane connection from River Valley Drive to Page Avenue Extension.

Creve Coeur Airport

Approved actions for the Creve Coeur Airport include a 4,500-foot runway and a 2,500-foot crosswind runway. Other improvements include expanded parallel taxiways and new hangars and service facilities. These improved facilities are expected to increase the number of base aircraft at the facility to over 325 by 2012 and increase flight operations from 48,000 in 1997 to 76,000 by 2012. The planned improvements were approved by MoDOT in the Final Environmental Assessment Report for the Airport in 1996.

Bicycle and Pedestrian System

The CCLMP provides an interconnected system of bicycle and pedestrian trails which currently follow the Creve Coeur Lake area and the upper bluffs of the Park. Recent expansion of the trail system has included trails south to the Page Avenue Extension. The current primary trail system is a minimum 8-foot wide asphalt trail throughout the Park including a new trail facility parallel to Creve Coeur Mill Road. The current trail system comprises 4.5 miles.

The trail system for CCLMP is planned for expansion from 4.5 to 15 miles as part of the CCLMP Park Master Plan. This expanded trail system includes additional trails in and around the Page Avenue mitigation lands and a planned future connection to the Katy Trail system.

4.3.2 Future Actions

Significant future improvements are being planned for expansion of the roadway network within the study area. These improvements can be defined as reasonably foreseeable by their current review or inclusion into the long-range transportation plans for the City of Maryland Heights and/or City of Chesterfield.

These reasonably foreseeable actions include the following improvements (Figure 4-1):

1. Extension of MHE south of Page Avenue to Olive Boulevard (four-lane facility expandable to six lanes).
2. Baxter Road Extension (Chesterfield Valley Spur) with overpass of I-64 along the existing Waterworks Road right of way to the MHE Extension. This roadway is planned as a two-lane facility expandable to four lanes and would have both east bound on and off access to I-64 and westbound access via the frontage road at Boones Crossing.
3. Relocation of Hog Hollow Road to east from River Valley Drive at Missouri American Water Treatment Plant.

Additionally, a system of roadways and collectors would be expected to be constructed within future developed lands to provide access to the local network.

Traffic modeling, forecasting, and analysis of roadway volumes in the Howard Bend area are critical to understanding the impact of new roadway improvements and land use growth on the transportation network. The traffic analysis for this area is very complex given the major transportation improvements being constructed or planned within or in proximity of the study area coupled with future land use growth. Traffic modeling is not an exact science but provides a means to anticipate an order of magnitude of traffic growth under various scenarios, given roadway types and land use growth.

It is important to recognize that many of the existing arterials in the region currently operate at Level of Service E or F (conditions characterized by intermittent and significant stops and delays caused by congestion) during peak periods. These would include I-70 (both east and west of the Blanchette Memorial Bridge), I-270, I-64, and various segments of Olive Boulevard. As a result of this congestion, any major improvements in the region can be expected to attract motorists from throughout the area.

In order to identify the potential attractiveness of the facilities in the Howard Bend study area, a travel demand model was used to forecast future traffic volumes. These analyses are critical to understanding the impacts that new roadway improvements and/or land use growth will have throughout the transportation network. The traffic analyses are very complex given the major transportation improvements being constructed or planned within or around the study area, particularly when coupled with the potential for significant future land use growth. Though travel demand modeling is an inexact science, it represents a valuable tool for preparing order-of-magnitude forecasts for the various scenarios.

Various sources of information were used to generate long-range traffic forecasts for the study area, including the following:

1. The EWGCC's Regional Travel Demand Model;
2. The Chesterfield, Missouri City-Wide Transportation Study prepared by George Butler Associates;
3. The City of Maryland Heights Traffic Model developed by CBB; and
4. The Howard Bend Land Use Plan.

Land use growth was based upon a range of assumptions regarding the potential types and densities of development. The Howard Bend Land Use Plan provided the basis for these assumptions by estimating development potential within each Transportation Analysis Zone (TAZ) that was established for the study area (Figure 4-2). Projected land use changes in each zone were used to estimate traffic generation that was aggregated with the reassignment of "external" traffic to the proposed road system.

Forecasted traffic volumes for roadways in the study area are summarized in Table 4-5. These volumes reflect 20 years of growth (a "design year" condition). It should be noted that due to the number of variables involved, projected volumes on these roads could be expected to vary by ±10 to 20 percent. Specifically, there is considerable potential variability in the following:

- The type and density of land uses that may actually be developed within the study area;
- The eventual treatment of external network constraints, such as the interchanges of Page Avenue (Route D) with Route 94 and I-270, could have a pronounced impact on the level of traffic that travels through the study area;
- The development of the road system within the study area, including the extent to which internal capacity constraints would be addressed with the construction of the proposed transportation system improvements; and
- The potential connectivity of the various facilities located within the study area (i.e., the connection of MHE with Water Works Road has a pronounced impact on some of the forecasts for the secondary roads).

Table 4-5. Long Range Traffic Forecast with Land Use Growth

Roadway and Segment	AADT Range
Page Avenue Extension (at Missouri River)	115,000 to 145,000
MHE – North of River Valley	37,000 to 53,000
MHE – North of Page Avenue Extension	47,000 to 63,000
MHE – South of Page Avenue Extension	49,000 to 65,000
Creve Coeur Mill Road (at Page Avenue)	4,000 to 11,000
Marine Avenue (at MHE)	8,000 to 11,000
River Valley Drive (south of Page Avenue Extension)	1,500 to 10,000
Relocated Hog Hollow Road (north of Water Works Road)	5,000 to 15,000
Water Works Road (west of MHE)	1,500 to 17,000
Baxter Road Extension (Chesterfield Valley Spur)	11,000 to 20,000

Source: CBB, 2003.

4.3.3 Regulatory Action

Neither the No Action (Case-by-Case Permitting) nor the SAMP alternative will directly impact transportation needs within the study area. However, any future transportation improvement that will require a Section 404 permit will have to comply with the requirements of the USACE Regulatory Program as discussed in Section 2.1.

4.4 Air Quality

Potential air quality impacts may be appropriately evaluated for both the construction and operation phase of a given project. Potential impacts associated for each phase are discussed below.

4.4.1 Construction Related Air Impacts

Each of the past and present actions have had the potential to increase the emissions of engine exhaust and fugitive dust within the study area due to earth moving activities during the construction phase. In most cases, smaller projects have not resulted in noticeable effects. In contrast, large earth moving projects such as the construction of the Riverport and Harrah's developments (and their associated levees), the construction of Page Avenue Extension, the

construction of the MHE, and the construction of the 500-year levee have invariably resulted in varying amounts of dust from exposed lands (depending on soil and wind conditions).

As with the past actions, each of the future actions represents a potential for soil disturbance and consequently, fugitive exhaust and dust emissions. Such effects will vary in magnitude with the overall magnitude of the project, timing, condition of the soil, and wind conditions. Potential effects are expected to be localized. Mitigative measures may be put in place, however, to reduce the duration and intensity of such effects. These measures may include such actions as watering dry areas or other methods as necessary to comply with MDNR air regulations limiting the emission of fugitive dust.

4.4.2 Operational Air Impacts

Common concerns associated with operational phase air impacts center on projects that constitute a single emission source (e.g., smoke stack effluent) and those that consist of linear (mobile) emission sources. Since manufacturing and industrial uses are presently limited (and subject to future limitations as per the City's Future Land Use Plan) this analysis is focused on transportation improvements that represent linear air emission sources.

Pollutants of common concern in highway planning studies are CO, O_3, and NO_x. The Howard Bend floodplain is located in an area where the SIP contains transportation control measures. As the designated Metropolitan Planning Organization (MPO) for the eight-county St. Louis metropolitan area, the EWGCC is required to prepare and approve the Transportation Improvement Program (TIP), a 5-year schedule of transportation improvements planned for the area, in order for these projects to use Federal funds. The CAAA requires that the TIP conform to plans to improve air quality in the St. Louis metropolitan area.

The control requirements for a nonattainment area are more stringent than for attainment areas. The MPO is responsible for making the conformity determinations, which for Federally funded projects must additionally be approved by the FHWA, the Federal Transit Administration (FTA), and USEPA.

Past and present transportation actions that are expected to carry significant vehicular traffic are the Page Avenue Extension and the MHE (see Section 3.3 for AADT). Extensive modeling efforts were performed in conjunction with the Page Avenue Extension as it was a Federally funded transportation improvement subject to the conformity procedures of 23 CFR Part 770. As a result, it was determined that Page Avenue Extension was in conformity with the SIP.

The MHE is a locally funded roadway that was not subject to the conformity procedures of 23 CFR Part 770. Consequently, there was no requirement to evaluate this project for regional impacts to air quality. Similarly, the future extension of the MHE south to Olive Boulevard is anticipated to be constructed using local funding. No Federal funds are anticipated to be used for either land acquisition or construction at this time. The effect of this future transportation improvement, however, will be to increase traffic volumes on the MHE as it draws traffic from other congested roadways such as I-270 and I-64. While no detailed analysis of air quality impacts has been conducted for this future action, it is likely that it will effectively reduce congestion on these associated roadways, and thereby improve local air quality conditions. The analysis of air quality impacts from the relocated Route 141 substantiates this conclusion. In the Draft Environmental Assessment for the Route 141 project, MoDOT reported that the air quality conformity analysis on the project completed by EWGCC found that the proposed improvements to Route 141 between Olive Boulevard and Route 40 would not significantly affect the conformity finding and would meet the Federal requirements of all the conformity tests (FHWA and MoDOT, 2001).

4.4.3 Regulatory Actions

Each of the regulatory alternatives under consideration is procedural in nature and will have no effect on air quality. Potential air quality impacts of projects subject to a Section 404 permit, however, will be evaluated in accordance with the current scope and limit of USACE Regulatory Program authority. Future projects subject to the 404 permitting authority of the USACE will be reviewed for conformity applicability pursuant to regulations implementing Section 176(c) of the CAAA. Those proposed activities that will not exceed *de minimis* levels of direct emissions of a criteria pollutant or its precursors will be exempted by 40 CFR Part 93.153. Any later indirect emissions are generally not within the USACE's continuing program responsibility and generally not practically controlled by the USACE.

4.5 Noise

The assessment of noise impacts from past, present, and reasonably foreseeable future projects may best be evaluated by considering noise impacts related to construction phase activities as well as those attributable to project operation.

4.5.1 Construction Related Noise Impacts

Construction related noise impacts are those associated with the periodic operation of machinery required in site preparation and facility construction. Sources of noise during the construction phase include earthmoving equipment and trucks, bulldozers, air compressors, generators, pile drivers, and other related equipment. The duration of such impacts is also anticipated to be relatively short and limited to daylight hours and the period of time required constructing a given project.

Each of the past, present, and reasonably foreseeable future projects under consideration has or will result in construction phase noise emissions. Such impacts are of relatively short duration and have been mitigated for by the use of appropriate noise control measures (i.e., mufflers, limits to the time of operation, etc.).

4.5.2 Operational Noise Impacts

As discussed in Section 3.5, baseline noise emissions within the study area are demonstrably higher in the vicinity of existing arterial roadways. Vehicular traffic, therefore, represents the primary noise emission source within the study area and also corresponds to the primary mode of noise impacts for any project considered as part of a cumulative impact analysis.

4.5.2.1 Past Projects

Several actions subsequent to 1985 have entailed improvements and expansion of the roadway system of the study area and have therefore, had an effect on the noise environment. For example, the construction of the Earth City Expressway and Page Avenue Extension are past projects that have or will alter vehicular use in the study area. Although direct noise emission levels are not available for the Earth City Expressway, predicted noise levels have been calculated for Page Avenue Extension. This facility will represent a new source of noise within the project when it is completed in late 2003. Noise modeling of this new roadway was performed using FHWA's STAMINA 2.0/OPTIMA noise programs. STAMINA 2.0 is a predictive model that is used to estimate future noise levels based on changes in vehicular volume and mix. Results of this analysis are presented in Table 4-6 for the three monitoring locations within the study area.

Table 4-6. Summary of Page Avenue Extension Noise Impacts

Location ID	Description	Baseline Noise Level (dBA)	Projected Noise Level-2015 (dBA)
QG	Creve Coeur Mill Road south of River Valley Drive	66.9	66.9*
QJ	CCLMP, along east side of Creve Coeur Lake along Page Avenue Extension	53.0	58.7
QK (Green-Black Alignment)	*Creve Coeur Mill Road at Waterworks Road*	*67.4*	*67.4**
5	Residence along River Valley Drive, west of Creve Coeur Airport	46.6	59.3

* No increase projected when geometrics are considered.

Source: TCT-St. Louis, Inc. 1992.

As a result of this action, noise levels within the floodplain will increase (when the roadway is opened in late 2003) approximately 5 dBA in the vicinity of upper Creve Coeur Lake, and approximately 13 dBA in the vicinity of River Valley Drive.

4.5.2.2 Present Projects

Among the present projects identified within the study area, the construction of the MHE represents the only project that is a potential significant source of operational phase noise. This transportation facility is anticipated to carry a traffic volume of approximately 6,000 to 15,000 AADT in 2003 and will, therefore, be a source of noise. For much of its length, this facility is close to and generally parallels the existing Creve Coeur Mill Road. It will also act as a reliever to the existing roadway and many travelers within the study area will likely use the new roadway rather than the existing facility. Consequently, many of the sources of noise generation on Creve Coeur Mill Road will be shifted to the MHE. This will result in a corresponding shift in noise levels (i.e., noise contours) as the new facility is generally located in undeveloped areas to the north and west of the existing roadway. As documented by TCT-St. Louis, Inc. (1992), the existing noise levels along Creve Coeur Mill Road were recorded at approximately 62 dBA north of Page Avenue Extension. The proposed volume of traffic on the new MHE is likely to cause slightly higher noise levels along the proposed roadway in accordance with the higher projected traffic volume.

4.5.2.3 Reasonably Foreseeable Future Actions

Several future actions represent roadway improvements that if implemented, will change the distribution and flow of traffic within the Howard Bend floodplain.

The future expansion of the MHE will extend a four-lane facility from River Valley Drive, through Page Avenue Extension, through a reserved corridor within the CCLMP, and terminating at relocated Route 141 at Olive Boulevard. This proposed roadway, funded by the City of Maryland Heights and scheduled for design and construction in 15 to 20 years, is expected to be an important arterial roadway that is projected to carry up to 65,000 AADT (see Section 4.3). Traffic generated noise levels will also be expected to increase within lands adjacent to the roadway. Such increases are expected to result in noise levels in excess of 65 dBA in close proximity to the roadway (NPS, 1995a). In areas that are in close proximity to Creve Coeur Mill Road, this will represent a slight increase over the background levels of 67 dBA, based on projected noise

levels associated with the Green-Black alternative for Page Avenue (see Table 4-6). In contrast, areas more distant from existing roadways such as the open lands within CCLMP near Little Creve Coeur Lake, will likely have a greater increase in noise levels (10 to 15 dBA) over background levels. These noise impacts, however, previously have been taken into consideration in recognition of the 109-acre reserved corridor in the CCLMP. NPS concluded that the presence of the roadway would impact noise levels within CCLMP, but that the benefits of the park alternative under consideration would offset these impacts (NPS, 1995b).

The Baxter Road Extension is another planned future action that will alter the flow and distribution of traffic in the area. If constructed, this facility will provide a connection from the Chesterfield Bottoms to the Howard Bend floodplain via River Valley Drive (and possibly Creve Coeur Mill Road). As a result, it is anticipated that this roadway will carry an estimated traffic volume of 11,000 to 20,000 AADT (see Section 4.3). As a consequence of this improved access, it is likely that development will occur within the River Valley Planning District in accordance with the City of Maryland Heights' Future Land Use Plan. The effects of these developments will significantly increase noise levels in this portion of the floodplain. Baseline noise conditions within the southern area of the Howard Bend floodplain are likely to be approximately 46 dBA (see MoDOT Receptor #5, Section 3.5). In contrast, resultant noise levels are expected to be approximately 10 dBA higher (i.e., approximately 56 dBA).

Other future actions are also likely to have an effect on noise levels. While some of these may contribute minor amounts of noise due to their operation (e.g., MSD plant expansion—operational noise), most noise level increases are again, likely to be associated with increases in traffic in conjunction with the proposed development. Development of unconstrained lands within the study area in accordance with the City of Maryland Heights' Future Land Use Plan (including the proposed Terra Vista Estates and Mill Ridge Villas in Chesterfield) will undoubtedly provide expanded use of the study area as a center for hospitality, recreation, and commercial businesses (and their associated employment). This will effectively increase traffic on the MHE, River Valley Drive and other roadways, and will cause a resultant increase in noise levels in surrounding lands. Timing of these future developments and hence, the corresponding increases in noise levels can not be predicted with certainty at this time.

A consideration of past, present, and reasonably foreseeable future actions indicates that these actions will have significant cumulative effects on the noise environment of the study area (Table 4-7). Noise levels are expected to be greatest in close proximity to existing and proposed roadway arterials and lower elsewhere as noise attenuates naturally over distance. Significant increase in noise levels are anticipated along future roadways planned south of Page Avenue (MHE Extension, River Valley Drive, and Baxter Road Extension). In the case of the MHE, the reserved corridor has been established at a width of 660 feet as a mitigative measure to minimize noise levels. This width was established based upon the 65 dBA noise contour as modeled by NPS in conjunction with the CCLMP Supplemental EIS (NPS, 1995a). The 65 dBA noise level is also used by FHWA as the threshold for noise impacts. A preliminary analysis of noise impacts associated with the future MHE extension suggests that noise levels along the proposed roadway could increase from 67 dBA (existing conditions) by 5 to 15 dBA (depending on terrain and distance to receptors). Such an impact may be more significant for those future residential receptors within the Terra Vista Estates and Mill Ridge Villas developments which closely abut (or are bisected by) the proposed MHE extension. At present, however, none of the proposed future roadway improvements are scheduled for Federal funding by FHWA. Consequently, these improvements would not be subject to noise abatement measures.

Table 4-7. Summary of Noise Impacts Associated with Past, Present and Reasonably Foreseeable Future Actions

Action	Noise Impact	
	Construction Phase	Operational Phase
Primary Action		
Alternative 1: Case by Case (No Action)	No Impact	No Impact
Alternative 2: SAMP	No Impact	No Impact
Past Actions	Short-term noise emissions for all projects	Long-term increases in noise levels along major arterial roadways (Page Avenue Extension, Earth City Expressway, Creve Coeur Mill Road: increases of less than 5 dBA near existing roads, but 10 to 15 dBA in previously undeveloped areas
Present Actions	Short-term noise emissions for all projects	Long-term increases in noise levels along MHE
Reasonably Foreseeable Future Actions		
1. Flank Levee System		
Alternative A	Short term	No Impact
Alternative B	Short term	No Impact
2. MHE Extension		
Options 1-5	Short term	Minor (<5 dBA) increases in vicinity of Creve Coeur Mill Road Significant (>65 dBA) noise levels in open lands such as CCLMP and increase 5 to 15 dBA (depending on terrain and distance to receptors) for residential receptors along Creve Coeur Mill Road
3. Baxter Road Extension		
Options 1-2	Short term	Significant (>10-15 dBA) increases in open lands Lower noise increases near Creve Coeur Mill Road
4. Hog Hollow Road Relocation	Short term	Similar noise levels along relocated road as exists along existing alignment
5. MSD Plant Expansion	Short term	Minimal operational impacts
6. Land Use Plan Development		
Scenario 1: Interim Condition	Short term	Noise levels increase along arterial roadways and secondary streets serving developed uses
Scenario 2: Ultimate Condition	Short term	Greater noise level increases along arterial roadways and secondary streets serving developed uses
7. Terra Vista Estates	Short term	No Impact
8. Mill Ridge Villas	Short term	No Impact
9. Creve Coeur Lake Dredging	Short term	No Impact

< = less than.
> = greater than.

4.5.2.4 Regulatory Actions

Each of the regulatory alternatives under consideration is procedural in nature and will not cause any changes in the noise levels within the study area. Additionally, the policies and procedures established by these actions will not result in other actions that will increase or alter the noise conditions of the study area or the region.

4.6 Natural Resources

4.6.1 Mineral Resources and Soils

As stated in Section 3.6.1, no mineral resources were identified within the study area. Sand is extracted from the Missouri River in St Charles County, and limestone is quarried from the Weber Quarry, but these activities are not located within the study area. Therefore, the past, present, reasonably foreseeable, and regulatory actions will have no impacts to mineral resources.

The soils within the study area were described in Section 3.6.2. The principle soils that will be impacted by the past, present, and reasonably foreseeable actions consist of the following: Eudora Silt Loam (rarely flooded), Booker Clay, Blake Silty Clay Loam, Waldron Silty Clay, and the Sarpy Loamy Fine Sand (rarely flooded). None of the soils within the study area are considered by the NRCS as highly erodible lands (HEL) or potential highly erodible lands (PHEL) (USDA, 1994). The lowland surface slopes and generally high clay content typically prevents high erosion rates for these soils.

4.6.1.1 Past and Present Actions

Each of the past and present actions (i.e., since 1985) have had the potential to increase soil erosion within the study area due to runoff from exposed soils and due to the effects of wind erosion. In most cases, smaller projects have not resulted in noticeable soil erosion effects. In contrast, large earth moving projects such as the construction of Riverport and Harrah's developments (and their associated levees), the construction of Page Avenue extension, the construction of the MHE, and the construction of the 500-year levee have invariably resulted in varying amounts of dust from exposed lands (depending on soil and wind conditions).

The increase in impermeable surface areas (roads, buildings, parking lots, etc.) prevents the direct infiltration of rainwater and increases the quantity and (typically) the velocity of surface water runoff. If mitigation measures are not taken, these changes can increase soil erosion. In addition, there is an increased potential for soil erosion during construction due to exposed soil. It should be noted that most of the existing land within the study area is currently used for row crops, which typically has higher soil erosion rates as compared to forested land or grassland. In all cases, the impacts of this soil erosion have been temporary (i.e., limited to the construction phase) and localized to the construction site.

4.6.1.2 Future Actions

As with the past actions, each of the future actions represents a potential for soil disturbance and, consequently, soil erosion. Such effects will vary in magnitude with the overall magnitude of the project, timing, condition of the soil, water, and wind conditions. Potential effects are expected to be localized. Mitigative measures may be put in place, however, to reduce the duration and intensity of such effects, and may include such actions as silt fencing, straw bales, and detention basins to prevent soil laden surface water from reaching streams and lakes. The extent of surface water impacts during construction will depend on adherence to appropriate standard erosion control measures

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As part of each action, storm water control is typically required in the form of a project specific detention basin that temporarily stores and treats (removes sediment) from surface water runoff. This also assists in preventing erosion within existing streams by slowing the release (quantity) and velocity of surface water runoff reaching the receiving streams.

Additionally, as stated in Section 3.6.1, the study area is located in a “moderate effect” seismic zone, but is an area that has a severe potential for liquefaction and amplification. Any potential development projects would likely require appropriate engineering considerations to accommodate design in such a seismic setting.

4.6.1.3 Regulatory Action

Site-specific erosion control requirements are expected to be operative for both the No Action alternative (Case-by-Case Permitting) and the SAMP alternative. Consequently, each regulatory action will work to minimize potential impacts from erosion. However, requirements for vegetated buffers around receiving surface water resources will be minimal under the No Action alternative. Consequently, erosion from construction sites and subsequent deposition within receiving surface water systems may occur to a greater degree than that evident under the SAMP alternative. By comparison, the SAMP alternative will require a more extensive and comprehensive buffer system that will intercept eroded materials and diminish sedimentation within receiving waters.

4.6.2 Land Cover

The assessment of cumulative impacts on land cover was undertaken by performing an historical trend analysis of changes in land cover within the study area. Identification of land cover conditions prior to the initiation of flood control within the Howard Bend area required that this analysis extend over an approximately 70-year period from 1928 to 2001. Black and white aerial photos for the study area were obtained for 1928, 1945, 1965, 1986, and 2001 and were used to identify and map cover types. This analysis established a context of environmental conditions that were used as a basis for evaluating the significance of impacts of past and present projects, as well as those associated with future actions.

4.6.2.1 Historical Overview

Initial presettlement land cover within the study area is likely to have been similar to that of other big river floodplains. As such, it may have consisted of a mosaic of bottomlands forest, wet prairie, marsh, and open water habitats (Theiling, 1999). By 1928, however, European settlement of the area had resulted in large-scale land clearing as agricultural uses accounted for 52 percent of the land cover (Figures 4-3 and 4-4). Lands that retained their natural character were either represented by larger wetland and open water complexes that were too wet to farm, or smaller fragments of uncleared land scattered across the floodplain. Non-wetland and non-agricultural cover types generally were poorly represented, each accounting for 3 percent or less of the total area.

By 1945, the percentage of agricultural lands had increased to 56 percent, reflecting a trend of continued land clearing and drainage of wetland habitats (e.g., northern reaches of the study area, see Figure 4-3). At the same time, USACE river training structures (wing dams) resulted in the landward accretion of sediments within the Missouri Riverfront. These processes resulted in both a slight increase in the acreage of wetlands within the study area and a concurrent decrease in open water as the Missouri River became more constricted.

Land cover trends from 1945 to 1965 reflected both a continued expansion of agriculture and an incremental increase in developed lands, grasslands, and forested lands. Agricultural land cover reached its highest point (among the years considered) in 1965, at which time it accounted for 65 percent of the study area. Little Creve Coeur Lake was entirely cultivated at that time as a result of the cutoff of the water inlet from Creve Coeur Creek and the initiation of surface water pumping from depressional areas. As a result, wetland habitats were at their lowest extent of all years prior to 1986, accounting for approximately 16 percent of the study area. Developed

lands, deciduous forest, and grassland increased in 1965 to 8 percent, 3 percent, and 2 percent, respectively.

By 1986, however, wetlands had redeveloped within a portion of Little Creve Coeur Lake and within the vicinity of Louiselle and Fee Fee creeks, and collectively accounted for approximately 22 percent of the study area. Deciduous forest continued to increase incrementally to 4 percent. Similarly, the percentage of grassland cover increased to 5 percent, reflecting a greater extent of maintained (mowed) areas within CCLMP, Creve Coeur Airport, and the primary levee along the Missouri River.

In summary, natural habitats and cover types within the study area have had a long history of being impacted by agricultural use. By 1986 native wetland and floodplain communities had been severely impacted as a result of land clearing and drainage alteration and had been limited primarily to the vicinity of Creve Coeur Lake, Little Creve Coeur Lake, and the area outside the levee along the Missouri River.

4.6.2.2 Past and Present Actions

Land cover conditions in 1986 represent the baseline conditions against which past and present actions may be evaluated. Effects of past and present actions are presented in summary form in Table 4-8 and are graphically represented in Figures 4-3 and 4-4.

Relative changes in land cover from 1986 to 2001 reflect the impact of these past and present actions coupled with on-going changes in the natural community, and changes in the nature of wetland regulation. For example, deciduous forest cover increased from 4 percent in 1986 to 11 percent in 2001 due to the continued successional development of lands both outside the primary levee system and the development of forested lands within CCLMP.

Wetlands declined markedly over the period as a result of a number of factors including impact from past and present actions (total impact of approximately 59 acres, see Tables 1-1 and 1-2), changes in mapping technique (use of 1987 USACE methodology rather than photo interpretation/soils), changes in regulatory programs and authorities (i.e., USACE and NRCS jurisdictional division and mapping methods)(see Section 4.7), and on-going pumping of surface water in the Little Creve Coeur Lake area. In contrast, however, the construction of the Page Avenue Extension, while impacting wetlands and other cover types, has had the effect of greatly expanding CCLMP as a result of compensatory mitigation. Much of this expansion has been associated with the acquisition of lands in the vicinity of Little Creve Coeur Lake. Agricultural uses within these areas effectively ceased in 2001 and these lands are in the process of reverting to a mosaic of wetland and non-wetland natural habitats.

Construction and development within the study area due to past project activity has primarily included actions associated with commercial business expansion, public utility improvements, transportation improvements, and expansion of recreational areas (see Table 2-3). These activities have had the greatest effect on agricultural land cover types, followed by old field, grassland, wetlands, deciduous forest, developed land, and open water (see Table 4-8).

The cover types considered to provide high quality wildlife habitat primarily include wetlands, deciduous forest, and late successional old field. The majority of wildlife reported to occur in the study area, including herpetofauna and sensitive avian species, primarily utilize these habitats for feeding, nesting, and roosting. Grassland, active farm field, and developed areas within the study area are generally considered low quality wildlife habitats due to limited opportunities for cover, nesting, and feeding habitats.

Table 4-8. Summary of Impacts to Land Cover Associated with Past, Present and Reasonably Foreseeable Future Actions

Action	Category						
	Cultivated Field	Developed Lands	Wetland	Grassland	Old Field	Deciduous Forest	Water
Primary Action							
Alternative 1: Case by Case (No Action)	NA	NA	No comprehensive management of natural resources other than that performed by St. Louis County Parks				
Alternative 2: SAMP	NA	NA	Comprehensive management of remaining natural resources using buffers, tree mitigation, and wetland mitigation policies				
Past Actions	919.6	38.5	58.7	9.9	136.7	45.7	5.4
Present Actions	373.8	36.6	<0.0	72.7	1.0	34.7	18.4
Subtotal	1,293.4	75.1	58.7	82.6	137.7	80.4	23.8
Reasonably Foreseeable Future Actions							
1. Flank Levee System							
Alternative A*	53.9	4.1	12.9	9.6	37.3	48.8	0.6
Alternative B†	82.9	9.5	15.2	12.1	61.0	49.5	0.0
2. MHE Extension							
Options 1-5	9.8-9.9	5.8-8.0	0.7-4.7	8.2-8.8	3.6-4.3	0.9-2.5	0.0-0.0
3. Baxter Road Extension							
Options 1-2	26.0-32.5	9.8-15.6	0.4-0.7	4.8-4.9	0.0-0.6	0.1-0.4	0.1-0.1
4. Hog Hollow Road Relocation	3.2	0.5	0.0	0.5	0.0	0.0	0.0
5. MSD Plant Expansion	0.3	0.8	2.4	0.2	40.1	0.0	0.0
6. Land Use Plan Development**							
Scenario 1: Interim Condition	1,617.4	178.9	49.1	125.6	82.8	25.3	16.7
Scenario 2: Ultimate Condition	1,617.4	178.9	49.1	125.6	82.8	25.3	16.7
7. Terra Vista Estates	0.0	0.0	0.0	7.3	0.0	0.0	0.0
8. Mill Ridge Villas	0.0	0.8	0.1	0.0	16.9	2.3	0.0
9. Creve Coeur Lake Dredging	40.6	0.0	0.0	18.2	4.5	38.3	0.0
Subtotal	1,751.2-1,786.8	200.7-214.1	65.6-72.2	174.4-177.6	185.2-210.2	115.7-118.3	16.8-17.4
Total	3,044.6-3,080.2	275.8-289.2	124.3-130.9	257.0-300.2	322.9-347.9	196.1-198.7	40.6-41.2

* In low range total.
† In high range total.
** Only Scenario 1 was used in totals to avoid double counting impacts for land use plan development.

In contrast to past development projects, present actions are focused on providing increased access to, and protection of developed properties through road and levee construction (see Table 2-3). In general, these projects have predominantly affected low quality habitats including active farm fields, grasslands, and developed lands (see Table 4-8). The MHE extension to River Valley Drive has, with the exception of the crossing over Creve Coeur and Fee Fee creeks, been entirely within agricultural fields, grasslands, and previously developed areas. Similarly, the construction of the 500-year levee by the HBLD has essentially been on the same alignment as the previous levee except where alignment modifications were made to relocate the existing levee out of the regulatory floodway. Improvements to this levee have entailed an increase in the overall height of the levee and the construction of a system of underseepage berms, which accounts for much of the additional lands (primarily cultivated field—see Table 4-8) that have been impacted by this action. The construction of the primary levee has also entailed the construction of several borrow sites (see Figure 3-7) that may develop wetland characteristics. Such areas (including the future wetland area constructed in CCLMP north of Little Creve Coeur Lake) have not been accounted for in Table 4-8 as they are not currently recognized as functional wetlands.

4.6.2.3 Future Actions

Potential effects of reasonably foreseeable future actions on land cover within the study area are summarized in Table 4-8 and are discussed below for each action.

Flank Levee System

The flank levee system is a major action that will have a notable effect on land cover. Direct impacts to land cover will primarily occur in conjunction with the excavation of lands immediately adjacent to the streams and riparian corridors contained within the flank levee system (i.e., Fee Fee Creek and lower Creve Coeur Creek), and the placement of fill required for the flanking levees. These activities could potentially result in the excavation and/or filling of between 12.9 and 15.2 acres of wetlands (Alternatives A and B, respectively) and approximately 49 acres of non-wetland riparian forests and old field habitats. It is likely, however, that the actual wetland impact of the flank levee system will be somewhat lower as demonstrated by HBLD's past efforts to avoid and minimize wetland impacts in the construction of the primary levee.

In its constructed condition, much of the flank levee system will be maintained with grasses and herbaceous vegetation. Woody vegetation will be periodically removed in order to maintain hydraulic flow under Alternative B. By comparison, Alternative A may incorporate management measures that will allow for redevelopment of some natural habitats within the flank levee system. Over time, such areas may include emergent wetland and shrub/forested riparian habitats. However, the location and extent of such habitat redevelopment has not been designed and is dependant on the HBLD's need to maintain the area for adequate stormwater detention and conveyance.

Indirect impacts associated with the flank levee system are those attributable to the effects of improved flood protection and its related effects on increased land development. While such development has not been identified, it is likely to result in the alteration of each of the land cover types identified, depending on its location, type, and specific characteristics.

MHE Extension

The extension of the MHE from Page Avenue to Olive Boulevard is an action that is anticipated to occur between 15 and 20 years in the future. Such an action will occur within a reserved transportation corridor within the CCLMP, and will have the effect of altering cover types within the CCLMP and within the Creve Coeur Creek valley. Dominant natural cover types at this time include cultivated fields, grasslands, wetlands, and old field habitats. Within 15 years, however,

the agricultural fields within CCLMP will have developed to natural habitats consisting of late successional old field, which would also be impacted by the proposed improvement.

Baxter Road Extension/Hog Hollow Road Relocation
The Baxter Road Extension is an action that will primarily affect low quality cover types (agricultural field, grassland, developed areas (see Table 4-8). Its primary alignment is anticipated to be along Water Works Road at the base of the bluffs and as such, would limit its impact to natural cover types. Similarly, the relocation of Hog Hollow Road will impact predominantly agricultural areas. Between 0.4 and 0.7 acres of wetland would be impacted with the proposed Baxter Road Extension.

MSD Plant Expansion
The expansion of the MSD Missouri River Plant is anticipated to be to the south of the existing facility and would therefore, result in impacts to approximately 40 acres of old field and approximately 2.4 acres of emergent wetland.

4.6.2.4 Future Land Use Development

The build out of unconstrained lands in accordance with the City of Maryland Heights' Future Land Use Plan would collectively represent the action with the greatest potential impact on land cover. In total, approximately 2,100 acres of lands may be converted if the land use development is complete within these areas (see Table 4-8). Primary land cover types affected include agricultural lands, grasslands, old fields and previously developed areas. A total of approximately 25.3 acres of deciduous forest and 49 acres of wetlands may be affected by this collective action. The extent to which these habitats will be impacted, however, will depend on the particular type of development planned, its location, and specific site characteristics. Additionally, the presence or absence of a flank levee system will also affect the rate at which these lands are developed and the characteristics of the resultant cover type. For example, in the absence of the flank levee system, developers will be required to provide more on-site stormwater detention and storage and will, therefore, be required to have wider ditch systems and detention basins. In contrast, the presence of a flank levee system will provide a central stormwater conveyance and detention system that will reduce the amount of lands needed for storm water control.

Terra Vista Estates and Mill Ridge Villas Developments
The proposed Terra Vista Estates development will alter approximately 7.3 acres of land. Land cover within the area affected by this project consists primarily of grassland habitats. Similarly, the Mill Ridge Villas development will alter approximately 0.1 acre of wetlands, 16.9 acres of old field habitats, and 2.3 acres of deciduous forest.

Creve Coeur Lake Dredging
Dredging of Creve Coeur Lake is planned to be conducted by hydraulic dredging. Slurry carrying the dredged materials will be deposited in each of two basins designed to retain the sediments (see Figure 2-9). Land cover types that will be impacted by this action include approximately 27 acres of agricultural field, 12 acres of grassland, and 38 acres of deciduous forest.

4.6.2.5 Regulatory Action

No direct impacts on land cover within the study area will occur with either the No Action (Case-by-Case Permitting) or the SAMP alternative. Indirect impacts expected with the No Action alternative include continued incremental habitat conversion and the lack of a cohesive approach to mitigation and compensation. In contrast, indirect impacts under the SAMP

alternative include a more cohesive approach to the preservation of natural habitats. Establishment of policies controlling buffer zones between new developments and natural habitats (especially wetlands and surface water resources) will indirectly provide for expansion of natural habitats and enhanced quality of the protected (buffered) resource.

4.6.3 Wildlife

Historical land cover alteration has resulted in changes in the habitat types (see Section 4.6.2.1) and their associated wildlife communities within the study area. Remaining high quality habitat types consist of vegetated wetlands, deciduous forest, and late successional old fields. Such areas support a variety of species that utilize these habitats for nesting, feeding, and roosting. In contrast, agricultural lands, grasslands, and developed areas provide a considerably lower habitat value due to a greater degree of disturbance and reduced habitat complexity (i.e., vegetation type). Alteration of these habitats results in both the displacement of wildlife and the direct mortality of those wildlife that are incapable of escaping land clearing activities.

Potential cumulative impacts to wildlife may be evaluated by focusing on the extent to which relatively high quality cover types are directly altered by past, present and reasonably foreseeable future actions. Indirect cumulative impacts may also relate to the extent to which these habitats are fragmented as well as potential effects on the movement or distribution of wildlife species.

4.6.3.1 Past and Present Actions

Past and present actions since 1985 have collectively resulted in a loss of approximately 80 acres of deciduous forest, 59 acres of wetlands, and 138 acres of old field habitat (see Table 4-8). In total, approximately 277 acres of these relatively high quality wildlife habitats have been replaced by low quality developed areas and grasslands. Consequently, these actions have effectively reduced the overall carrying capacity of the study area for wildlife species associated with these habitats.

Several of these actions have fragmented existing habitats and isolated or limited the movements and dispersal patterns of wildlife populations. For example, transportation improvements such as the Page Avenue Extension and the MHE have bisected or reduced the contiguity of forested and riparian habitats. In the case of the MHE, these effects have been limited to the riparian corridor along Fee Fee Creek and the impacts to approximately 29 acres of deciduous forest along lower Creve Coeur Creek. In contrast, Page Avenue Extension resulted in significant impacts to the natural habitats within CCLMP, fragmentation of forested areas along the Missouri River, and the bisection of Little Creve Coeur Lake. (It should be noted that at the time, land cover in the Little Creve Coeur Lake area was predominantly low quality agricultural lands.) In recognition of the magnitude of these impacts however, MoDOT was compelled to provide significant compensation in the form of land acquisition, subsequent dedication of those lands to CCLMP, and wetland mitigation. With the cessation of agricultural practices in the Little Creve Coeur Lake area, the effect of this compensation has been to greatly expand the wildlife habitat and use of the study area. Indeed, as is discussed in Section 3.6.3.2, additional natural habitats within CCLMP (open water habitat of sedimentation basin and acres associated with Little Creve Coeur Lake) have undoubtedly contributed to the high species richness of bird use within the study area. In total, 1,102 acres of land were added to the CCLMP as part of the Page Avenue mitigation package. These areas are being managed by St. Louis County Parks Department as open, natural habitats for wildlife use and outdoor passive recreation. Additionally, an area totaling 113 acres (wetland and upland buffer) has been established by MoDOT for wetland mitigation (see Section 4.7). Again, despite the impacts

cited above for the Page Avenue Extension, the mitigation effort promises to provide important wildlife habitat in the future.

The construction of the 500-year levee by the HBLD has resulted in habitat alteration as discussed in Section 4.6.2.2. However, this action has also entailed the creation of open water (and future potential wetland) areas as a result of the need to obtain borrow material for the construction of the levee. These areas include several open water habitats as illustrated in Figure 3-7. Wildlife value of these water bodies is apparent, as they are used by waterfowl, wading birds, shorebirds, and other wildlife.

4.6.3.2 Future Actions

The majority of reasonably foreseeable projects that are planned to occur within the study area will entail the conversion of a variety of wildlife habitats to impermeable surfaces for the development of roads, commercial buildings and associated parking, housing, and utility expansion (see Table 2-3). The impacts to wildlife from each potential future action will vary with each action's corresponding effect on natural habitats, but will include the generalized mechanisms of wildlife impact discussed earlier in this section (i.e., displacement, direct mortality, reduced carrying capacity, etc.). Table 4-8 provides a summary of the potential impacts to valuable wildlife habitats with each future action. A discussion of some of the future actions having more significant implications for wildlife impacts are provided below.

Flank Levee System

The flank levee system proposed by the HBLD will have varying impacts on wildlife, depending on the option that is ultimately implemented. During the construction phase, each alternative will result in the loss of up to 65 acres of riparian habitats along lower Creve Coeur and Fee Fee creeks. The extent to which this impact will occur, however, is at present not known as detailed design plans have not yet been prepared. By comparison, the absence of a flank levee system that is assumed under land development Scenario 1 would not impact land cover along these creeks, see below. This clearing and excavation activity will result in localized direct mortality of less mobile faunal species and will displace more mobile species.

Once implemented, however, the effects of each alternative differ. In the case of Alternative A (gated discharge at the Missouri River), selected natural communities (emergent, scrub shrub, forested) may be allowed to become established within the interior of the levee system, thereby providing valuable wildlife habitat. Additionally, depending on the extent to which such plant communities are allowed to become reestablished, they may enhance the connection between the natural communities of the bluff area and the riparian habitats along the Missouri River. Under conditions in which the Missouri River is elevated, creek flow and stormwater runoff may be stored within the flank levee system, thereby providing value to fish and wildlife.

For Alternative B (gated discharge at the Creve Coeur Creek and Fee Fee Creek junction), the flank levee system will be open to the Missouri River, thereby allowing flood water to enter the system during periods of elevated river stage. As compared to Alternative A, this alternative entails a narrower channel and more dynamic water level fluctuations that would provide shorter durations of available open water habitat, decreased open water surface area, and less potential for the development of emergent wetlands. Additionally, woody vegetation establishment along channel margins would be limited with this alternative due to the potential for trees to impede the conveyance of creek flow and stormwater runoff to the Missouri River. A benefit to wildlife from open discharge design to the river may be the seasonal use of lower Creve Coeur Creek by various fish species and waterfowl. The value of this feature as fish habitat, however, is not clear, as final design and management procedures that would affect the degree and quality of open water habitat have not been developed.

MHE Extension

The extension of the MHE to Olive Boulevard will result in the displacement of wildlife during construction and the fragmentation of the habitats within the Creve Coeur Creek valley and Little Creve Coeur Lake portion of CCLMP. While these habitats are of relatively low quality today, it is expected that in 15 years they will take on a character equivalent to late successional old field and as such, may provide valuable wildlife habitat. Future roadway development will bisect these habitats causing isolation of faunal populations and an increased opportunity for roadkill. The construction of the roadway on structure in the Creve Coeur Creek valley will, however, result in a reduced incidence of roadkill along this segment of the MHE Extension.

4.6.3.3 Future Land Use Development

Potential development in accordance with the City of Maryland Heights' Future Land Use Plan will effectively displace wildlife associated with natural habitats of the unconstrained lands in the study area. Complete alteration of the habitats identified in Figure 2-11 is assumed with both development scenarios (i.e., with and without flank levees). What differs among the two scenarios is the rate at which habitats are modified and the extent of stormwater conveyance and detention that is required for each local site development (see Section 2.2). The effects of this development will be to eliminate isolated populations of species that are limited to small habitat "islands;" sustain and enhance the presence of fauna that are tolerant to developed uses and capable of feeding, hiding, and resting in such areas; and limit faunal use for many species to those habitats preserved within CCLMP, the Missouri Riverfront, and the riparian corridors along lower Creve Coeur and Fee Fee creeks.

Scenario 1 also differs from Scenario 2 with regard to the intrinsic level of impact to natural habitats along lower Creve Coeur, Fee Fee, and Louiselle creeks. In particular, Scenario 1 assumes the absence of a flank levee system which would eliminate or reduce land cover alteration along these creek systems.

Baxter Road Extension

This future action will comparatively result in relatively low impact to wildlife populations within the study area. Though it would cross the riparian corridor of Bonhomme Creek, it is expected to be constructed on a bridge at this location, thereby minimizing potential impacts to wildlife. Depending on the location alternative selected, however, this action may include an eastern terminus at Creve Coeur Mill Road (future MHE Extension) that will create a 66-acre remnant within the 6(f) lands of CCLMP (see Figure 2-8). Effects to wildlife associated with this action would be similar to the fragmentation impacts previously discussed above for the MHE Extension.

Creve Coeur Lake Dredging

Dredging of Creve Coeur Lake is a future action that was a condition of the permit for the Page Avenue Extension. This action will have detrimental impacts to wildlife in that it will require the construction of a sedimentation basin in a forested area of CCLMP that presently provides good wildlife habitat. Conversely, it will deepen Creve Coeur Lake and will improve its function and value as a fishery.

4.6.3.4 Regulatory Actions

As described in Section 2.1, the No Action regulatory alternative may result in the continued fragmentation and loss of wetland acreage and landscape functional value.

The intent of the SAMP is to implement long-term environmental planning to minimize resource impacts within the study area. With the exception of cultural resources protection, all SAMP functions provide direct benefits to wildlife. Wetland protection and preservation will designate wetlands and creeks for protection from development, thereby preserving the highest quality wildlife habitats and increasing habitat interconnectivity within the study area (see Figure 2-1).

In combination with the location of 4(f) and 6(f) mitigated lands within the new boundaries of CCLMP, the acreage and quality of protected land available for wildlife use will greatly increase (see Figure 3-3). Additional wildlife benefits will be gained by a refined mitigation process. The mitigation of unprotected wetlands will require functional assessments in addition to acreage quantifications to ensure no net loss of functional values. Mitigation banks may be designed to provide maximum functional values and will be protected in perpetuity.

In addition to wetland preservation and mitigation provisions, the SAMP will include provisions for tree mitigation, vegetated buffers and erosion control methods to enhance and protect water quality.

4.6.4 Sensitive Species

Significant habitat alteration that may have had the potential to adversely affect sensitive species had occurred historically, as a result of large-scale activities (extending well beyond the study area) that included land clearing and the installation of river training structures. Such historical activities have had pronounced landscape effects and have altered the distribution and quality of floodplain and riverine habitats. While it is not possible to be specific, the consequence of these previous actions has undoubtedly been to increase the rarity of species.

4.6.4.1 Past and Present Actions

Potential impacts to threatened and endangered species are given consideration as part of the USACE's permit review process. As a result, the effects of past and present actions (i.e., those subsequent to 1985) on sensitive species had previously been given consideration by USACE for actions requiring a Federal permit. No significant adverse impacts were reported to occur as a result of any of the previously permitted past or present actions.

Conversely, it may be important to note the positive effects of habitat preservation. Management and preservation of natural habitats in CCLMP (including 153 acres of wetlands) and the expansion of natural habitat preservation in the vicinity of Little Creve Coeur Lake as a result of the Page Avenue mitigation package have been beneficial to sensitive species. As is presented in Table 3-20, a large number of species of conservation concern have been reported within CCLMP in recent years. The presence of these species (many of which are water/wetland dependant) reflects the value of these preserved lands as predominantly foraging and resting habitats. As these habitats continue to develop (especially those in the Little Creve Coeur Lake area) they will likely provide more stable habitats that will also be suitable for nesting by some of these species.

4.6.4.2 Future Actions

Potential future actions within the study area are not expected to have a significant adverse impact on sensitive species. While the various actions under consideration in this EIS will have the effect of habitat alteration (see Section 4.6.2.2), potentially affected high quality natural habitats are generally limited in their distribution and overall suitability to support sensitive species.

4.6.4.3 Regulatory Actions

Previous USACE regulatory program actions resulted in the permitting of 31 actions within the study area since 1985 (see Table 1-1). As previously stated, none of these actions resulted in significant adverse effects on sensitive species. Similarly, it is not expected that future actions individually permitted by the USACE on a case-by-case basis will have a significant effect on sensitive species.

Future permitting under the SAMP alternative is also not expected to have any adverse impacts on sensitive species. However, a more cohesive approach to mitigation may further enhance the study area's capacity for support to sensitive species. The consolidation of mitigation requirements in a fewer number of mitigation areas, coupled with the long-term preservation of mitigation areas will likely expand and enhance habitat quality and interconnectivity the use of the study area by sensitive species.

4.7 Wetlands

Past and present actions have had a considerable effect on wetlands of the study area, but such effects are properly evaluated in the context of more long term use of the area. Consequently, the assessment of cumulative effects on wetlands was performed in conjunction with the trend analysis described in Section 4.6.2.1. Wetland distribution and extent were established historically for 1928, 1945, 1965, and 1986 by photo interpretation. Wetland extent for 2001 was established using the methodologies described in Section 3.7.

4.7.1 Historical Overview

Based on the distribution of hydric soils and the close association of the study area to the Missouri River, it is likely that a large portion of the pre-settlement study area was composed of wetlands. Settlement of the area in the 1800s led to clearing (and presumably drainage) of many wetlands as is reflected by the land cover map from 1928 (see Figure 4-3). Despite these wide-scale clearing activities, it is estimated that approximately 23 percent of the study area consisted of wetlands at that time (see Figure 4-3). Complexes of forested and scrub shrub wetland were well represented (see Figure 4-3) and existed in undrained oxbows and channel scars of the study area including Creve Coeur Lake, Little Creve Coeur Lake, and the northern reaches of the study area.

Over the subsequent intervening years, wetlands losses continued within the study area as more lands were converted to agricultural uses. Notable characteristics of the effects to wetlands within this time period include the following:

- Active pumping of surface water within Little Creve Coeur Lake area has been conducted since the 1970s;
- Levee construction beginning in the 1930s;
- Expansion of levee construction using mechanized equipment after World War II;
- Diversion of flow from Fee Fee Creek and lower Creve Coeur Creek from the north oxbow wetland complex in the northern reaches of the study area directly to the Missouri River;
- Wide scale development of watersheds of Creve Coeur and Fee Fee creeks, resulting in deposition of eroded materials in wetlands of the study area; and
- Expansion of actively cultivated lands to approximately 53 percent by 1986.

Effects of these various activities on wetlands of the study area were to remove wetland hydrology, clear and remove established wetland vegetation, displace wetland fauna, disrupt

wetland soils through cultivation, and increase sediment and pollutant transport to wetlands due to the effects of increased soil erosion.

Several historical actions, however, have resulted in the expansion of the wetland resource (albeit somewhat temporary). For example, placement of river training structures (wing dams) in the 1940s had the effect of expanding wetlands in the vicinity of Jane Downing Island. Continued accretion of sediments within this area has, however, reduced the extent of such wetlands in recent years (see Figure 4-3 versus Figure 3-5).

4.7.2 Past and Present Actions

The aggregate impact of past and present actions on wetlands is presented in Table 4-9 and is illustrated by type in Figure 4-5. In total, 55.3 acres of wetlands have been impacted since 1985. In most cases these impacts were subject to regulation by the USACE under Section 404 of the CWA. However, in at least one case, an additional 3.4-acre wetland was impacted using "clean excavation" techniques allowed under the Tulloch Rule. Many of these past permits had mitigation requirements as was presented in Table 1-1. However, past and present actions have not always been effective in mitigation (thus, replacing) for impacts to wetlands. Functional performance of these mitigation wetlands has not been assessed but is likely to be mixed as several of these mitigation sites are small, isolated, and poorly managed. As is presented in Table 1-3, there is a deficit of approximately 21 acres of wetland mitigation within the study area. Additionally, MoDOT has expressed concern about their ability to restore all the planned wetlands within its mitigation site due to inadequate hydrology. While MoDOT is seeking a solution to this problem, the USACE maintains its concern regarding the viability of the entirety of the mitigation site.

Past borrow pit construction for the 500-year levee (see Figure 3-7) has also resulted in the creation of several areas that may develop wetland characteristics. For example, the development of a borrow site within the CCLMP north of Little Creve Coeur Lake entailed the seeding of a 20-acre emergent wetland and the creation of a 14-acre shallow open water area. Other wetland areas may be expected to develop voluntarily in some of the other borrow sites.

4.7.3 Future Actions

Impacts of each of these actions may be evaluated in terms of direct wetland conversion due to the placement of fill (i.e., project "footprint") and in terms of indirect effects. Indirect impact to wetlands common to most actions under consideration may result from alteration of wetland hydrology (changes in flow patterns, watershed area, etc.), and isolation or fragmentation of wetlands. Degradation of water quality may also occur due to the effects of erosion and sedimentation, increased nutrient loading, and reduced shading by riparian vegetation.

Potential direct impacts to wetlands have been assessed for each future action and are summarized in Table 4-9. Potential future actions that are anticipated to result in little or no wetland impacts include the Hog Hollow Road relocation, Terra Vista Estates and Mill Ridge Villas developments, and the dredging of Creve Coeur Lake. It is estimated that all other actions will result in unavoidable impact to wetlands as reflected in Table 4-9. It should be noted that values presented in Table 4-9 are based on current wetland mapping (see Figure 3-6) and do not reflect potential changes that may occur in the near future. Such changes are expected to include the USACE's "capture" of wetlands formerly designated at Prior Converted (PC) by the NRCS. Such wetlands are known to occur in the vicinity of Little Creve Coeur Lake. The USACE intends to assert its authority over such lands if they demonstrate wetland characteristics 5 years after the cessation of agricultural activities.

Table 4-9. Summary of Impacts to Wetlands Associated with Past, Present and Reasonably Foreseeable Future Actions

Action	Wetland Type				
	Total	Farmed wetland	Emergent Wetland	Scrub Shrub Wetland	Forested Wetland
Primary Action					
Alternative 1: Case by Case (No Action)	NA	Preservation of wetlands in CCLMP, Riverside of HBLD levee			
Alternative 2: SAMP	NA	Preservation of wetlands in CCLMP, Riverside of HBLD levee, upper Creve Coeur Creek, Louiselle Creek			
Past Actions	58.7 (55.3 permitted, 3.4 acres due to "clean" excavation)				
Present Actions	<0.1				
Subtotal:	58.7				
Reasonably Foreseeable Future Actions					
1. Flank Levee System					
Alternative A	12.8	1.3	1.4	1.5	8.6
Alternative B	15.1	1.3	1.0	1.5	11.3
2. MHE Extension					
Options 1-5	0.7-5.0	0.0	0.0	0-1.3	0.7-3.7
3. Baxter Road Extension					
Options 1-2	0.4-0.7	0.1-0.1	0.0-0.3	0.0-0.0	0.3-0.3
4. Hog Hollow Relocation	0.0	0.0	0.0	0.0	0.0
5. MSD Plant Expansion	2.4	0.0	2.4	0.0	0.0
6. Land Use Plan Development					
Scenario 1: Interim Condition	49.1	17.2	10.5	0.1	21.3
Scenario 2: Ultimate Condition	49.1	17.2	10.5	0.1	21.3
7. Terra Vista Estates	0.0	0.0	0.0	0.0	0.0
8. Mill Ridge Villas	0.1	0.0	0.0	0.0	0.1
9. Creve Coeur Lake Dredging	0.0	0.0	0.0	0.0	0.0
Subtotal	65.5-72.4	18.6-18.6	14.3-14.2	1.6-2.9	31.0-36.7
Total (Grand)	186.9-201.1				
* Subject to revision as a result of a recent field determination.					

4.7.3.1 MHE Extension

The extension of the MHE from Page Avenue to Olive Boulevard is anticipated to impact from 0.7 to 5.0 acres of wetlands, depending on the final location and design of the roadway. The roadway is expected to be on fill through the reserved corridor from Page Avenue to near Creve Coeur Mill Road. Differences in potential impacts of options considered for this action are predominantly associated with the extent of bridging that is used in the construction of the facility.

4.7.3.2 MSD Plant Expansion

The anticipated expansion of MSD's Missouri River Plant is expected to impact approximately 2.4 acres of wetlands. It is expected that the expansion of the existing facility will occur to the south, which will result in impacts to a small emergent wetland.

4.7.3.3 Flank Levee System

The construction of the HBLD flank levee system will affect a number of small wetlands including those along lower Creve Coeur Creek, Fee Fee Creek, and Louiselle Creek. Construction of this stormwater control facility will entail excavation of a secondary channel adjacent to the existing stream system (i.e., inside the flank levees) to an elevation equivalent to the existing stream bed. This activity will result in impacts between 12.8 to 15.1 acres of wetland (Alternative A versus Alternative B) and several hundred feet of riparian corridors. [Note: Actual magnitude of impact based on final design not yet developed.] Differences in these alternatives are accounted for by differences in location of the levee and the need for an underseepage berm for Alternative B. These excavation and fill activities will result in impacts on the water quality of these streams as a result of the effects of erosion and sedimentation. Such impacts, however, are expected to be short term in their duration and minimized though the use of best management practices (BMP) including erosion and sedimentation control measures.

Subsequent to the construction phase, varying amounts of wetlands may be expected to redevelop within the flank levee system. Such wetland redevelopment may be greater with Alternative A as compared to Alternative B, as Alternative A will incorporate a wider flank levee interior and may allow for incorporation of such features in the final design. Additionally, Alternative A may also incorporate maintenance plans that allow for some redevelopment of riparian areas and scrub shrub and forested wetlands within a portion of the levee interior.

Each of the flank levee alternatives and ensuing localized drainage systems have the potential to cause significant indirect impacts on wetland hydrology. By controlling overbank flooding from local creeks, and by enhancing the removal of ponded water from lands outside the levee, the flank levees will reduce or remove hydrology from interior wetlands. This will effectively remove such areas as jurisdictional wetlands and make them more vulnerable to development.

By comparison, the absence of a flank levee system (see Scenario 1 under Future Land Use Development, below) would not result in impacts to wetlands along lower Creve Coeur, Fee Fee, and Louiselle creeks.

4.7.4 Future Land Use Development

Development of the study area in accordance with the City of Maryland Heights' Future Land Use Plan will also result in wetlands impacts. While this development may be expected to be somewhat different under each scenario, wetland losses within developable lands (see Figure 2-1) are assessed at 100 percent for both options. However, because Scenario 1 assumes that no flank levee will be constructed, it would result in between 12.9 to 15.2 acres of less wetland impact than Scenario 2. Under Scenario 1 (no future flank levee system) development is expected to occur at a slower pace, and will be required to incorporate more local flood storage and stormwater detention. Interior wetlands will, therefore, likely be converted to buildings, parking lots, and detention basins. By comparison, development of these lands under Scenario 2 (flank levee system in place) is expected to occur more rapidly and with less on-site storage and detention.

4.7.5 Regulatory Action

Wetland resources lie at the center of the primary action under consideration. While not resulting in direct and immediate effects to wetlands, each regulatory alternative being considered exerts an indirect impact on the wetland resource by virtue of its effect on the permitting policy and process. The relative effects of each of the alternatives under consideration may be assessed in terms of both wetland preservation and mitigation. Each of these characteristics are discussed below.

4.7.5.1 Preservation

For the SAMP alternative, several wetland areas have been identified for preservation and are, therefore, not subject to future development. As is indicated in Table 4-10, much of this area is currently in public ownership (e.g., CCLMP) and is, therefore, already subject to long-term preservation. In such cases, the effect of the SAMP, therefore, is to further reinforce the long-term preservation and management of wetlands within these areas. For the Missouri Riverfront Planning District, use of these lands is controlled by the City of Maryland Heights through their Future Land Use Plan. However, few lands on the riverside of the 500-year levee are in public ownership. Consequently, the effect of the SAMP in such areas will be to further constrain uses within these areas and to preclude wetland conversion and loss.

Table 4-10. Existing Wetland Areas to be Preserved Under the Regulatory Alternatives

Area Description	Controlling Authority	Acreage of Preserved Wetlands	
		SAMP Alternative	No Action Alternative
Creve Coeur Lake Area	St. Louis County Park	123.0	123.0
Little Creve Coeur Lake Area	St. Louis County Park	30.4	30.4
Riverside of 500-year Levee	City Land Use Controls	329.6	Limited
Total		**483**	**153.4**

Table 4-10 also identifies several additional areas that are afforded long-term wetland preservation. Wetlands within these areas are composed of a variety of community types (emergent, scrub shrub, forested—see Section 3.7) and were selected by the USACE for long-term preservation due to their overall functional value and their location with respect to other features within the study area. For example, scrub shrub and forested wetlands along upper Creve Coeur Creek are closely linked to the wetlands of Creve Coeur Lake.

By comparison, the No Action alternative would also result in wetland preservation. Wetlands presently located within CCLMP would be sustained in conjunction with the Park's goal to manage such areas as open natural habitats. Additionally, previously established wetland mitigation sites will be preserved in accordance with covenants and restrictions limiting the use of those parcels.

4.7.5.2 Mitigation

As discussed in Section 2.1.2, project applicants requesting a Section 404 permit must demonstrate that they have taken all appropriate measures to avoid and minimize effects to wetlands, prior to the USACE giving consideration to mitigation of impacts. Under both the No Action (Case-by-Case Permitting) and SAMP alternatives, mitigation of impacts to wetlands would be undertaken in response to the needs of each project being permitted. This would be prescribed by the USACE (and the MDNR through the Water Pollution Control Program-Section

401 Water Quality Certifications) in accordance with the following general national policy and agency guidance requirements:

- Presidential policy and USACE Headquarters' policy as to "no net loss" of wetlands.
- RGL-02-02, December 24, 2002, directing USACE mitigation policy to
  - Use functional assessment tools,
  - Improve mitigation performance standards, and
  - Impose stronger requirements for monitoring of wetland mitigation sites.
- MDNR Stream and Wetland Mitigation Guidelines.

These general policies and guidance requirements are effective for both the No Action and SAMP alternatives and provide an overall mitigation framework which ensures (1) that wetland impacts are actually mitigated, and (2) greater likelihood that such mitigation efforts will be functionally effective. These policies however, do not specify where such mitigation may occur, nor do they establish overall requirements for wetland management. In the case of the No Action alternative, wetland mitigation may be expected to occur in a piece-meal fashion in response to the needs of each individual project. This may result in small, isolated mitigation sites with low functional value and poor management. Additionally, the No Action alternative may result in an overall net loss regionally (i.e., within the study area) as such mitigation requirements may be fulfilled at an off-site location (e.g., a mitigation bank, see Section 2-1 and Table 1-1). In contrast, the SAMP alternative would require that mitigation be undertaken at one of several centralized locations within the study area. Such mitigation sites are likely to be in close association with other wetland and surface water resources and consequently, would be expected to exhibit greater overall functional value. Additionally, the wetland bank would be administered by a public or private entity and would consequently be precluded from future development and subject to an active and responsible management program.

4.8 Water Resources

4.8.1 Surface Water Resources

Surface water resources within the Howard Bend study area have undergone considerable alteration as a result of past uses. In order to establish the context within which the effects of past, present and reasonably foreseeable future actions may be evaluated, an historical trend analysis was conducted. The results of this analysis and the assessment of cumulative impacts are presented below.

4.8.1.1 Historical Overview

An assessment of historical changes in surface water resources and its related effects on water quality may be undertaken by measuring the degree to which streams and lakes of the study area have been altered by man's activities. This analysis was performed by integrating information from a number of sources including the following:

- Photointerpretation of black and white aerials from 1928, 1945, 1965, 1986, and 2001;
- Review of MDNR water quality data and 303d lists of impaired waters;
- Review of USACE 404 permits relating to channel improvements and streambank stabilization; and
- Incorporation of local oral history from long-time residents.

As discussed in Section 4.6.2.1, a long history of agricultural use has resulted in significant alteration of the Howard Bend floodplain. The changes in land cover discussed in this previous section were paralleled by the construction of a continuous agricultural levee from Bonhomme Creek north to the current location of I-70, the development of agricultural flank levees adjacent

to the Creve Coeur and Fee Fee creeks channels (20 to 40 year protection), and significant alterations to the streams and lakes of the study area. Notable changes during this "pre-regulatory" era (i.e., prior to USACE's Section 404 program) included extensive channelization of streams, alteration of surface water flow patterns, elimination of seasonal flooding of lands adjacent to the Missouri River, and drainage and pumping of surface water.

Channelization and diversion of streams has been progressive over the historical period. Maps from the late 1800s suggest that flow from Creve Coeur Creek once entered Little Creve Coeur Lake. Results of photo interpretation since 1928 have shown that more than 5.8 miles of streams within the study area have been channelized (Figures 4-6 and 4-7). Comparatively, only 2.2 miles of stream channel are present that retain predominantly the characteristics of a naturally meandering channel. Similarly, a significant alteration of the drainage pattern of Creve Coeur Creek occurred some time after 1945 when the cutoff channel (now lower Creve Coeur Creek) was constructed to carry flow from Creve Coeur Creek and Fee Fee Creek directly to the Missouri River (see Figure 4-6). Effects of these historical activities has been to increase flow velocities, increase channel scour, and increase erosion and turbidity levels of the creek systems. Primary areas in which channelization was evident from aerial photos (actual dates of channelization are not known) included lower Creve Coeur Creek (1965), upper Creve Coeur Creek (1965, 2001), Fee Fee Creek (1965), Louiselle Creek (1945), and Bonhomme Creek (1986). In many areas, riparian vegetation has become established along these modified streams. Width and composition of this zone varies with the nature of adjacent land uses and the degree of continued disturbance.

Efforts to improve navigability of the Missouri River were undertaken by the placement of river training structures (wing dams) by the USACE in the 1930s. These structures were effective navigation improvements, but had the effect of reducing the river's overall width and channel complexity, as is evident in Figure 4-3. The net local effect of this action has been to stimulate the accretion of sediments along the right descending shoreline, and thereby reduce the amount of available surface water within the study area.

Non-point source pollution including erosion and subsequent sedimentation has also been a source of surface water degradation. Sedimentation within Creve Coeur Lake and Little Creve Coeur Lake have reduced water depth and diminished water quality. Agricultural land uses were also observed to be historically conducted in close proximity to many surface water features (creeks, lakes and the Missouri River) with little or no adjacent buffer or riparian zone. The inevitable result of such practices would have been to increase runoff, increase pollutant and nutrient loading, and increase erosion. Significant development within the upland watershed of Creve Coeur Creek also had the effect of degrading the water quality of Creve Coeur Lake. As discussed in Section 3.8.1.2, Creve Coeur Lake was included on the 1998 list of waters designated under Section 303(d) of the Federal CWA due to chlordane contamination. Presumably, this chlordane had been carried to the lake by runoff from developed and agricultural areas within its watershed.

Surface water resources have also been affected by active pumping of surface water to accelerate the use of such areas for cultivation. This has particularly been the case within the Little Creve Coeur Lake area where local residents have indicated that pumping of surface water has occurred since the 1970s (Stemme, personal communication). As a result of the purchase and subsequent donation of many of these lands to CCLMP for use as outdoor recreational areas and wetland mitigation (MoDOT), the active pumping of surface water has been ceased.

4.8.1.2 Past and Present Actions

Few actions subsequent to 1985 have had a significant effect on surface water resources. This may in large part, be attributable to the effect of the USACE's regulatory program in requiring permit applicants to "avoid and minimize" impacts to surface water resources.

Projects that have affected surface water resources since 1985 include those associated with roadway construction, channel improvements, and levee construction. In the case of roadway construction, bridging of Creve Coeur Creek and the Missouri River by the Page Avenue Extension and bridging of Fee Fee Creek and lower Creve Coeur Creek by the MHE have resulted in only minor impacts, as these actions have spanned the creek channels. In the case of the Page Avenue Extension, however, some significant positive effects to water quality have been realized by the construction of a sedimentation basin to intercept and detain sediments carried by Creve Coeur Creek prior to their deposition in Creve Coeur Lake. This same action, however, also resulted in the rechannelization of a portion of Creve Coeur Creek upstream of Creve Coeur Lake (see 2001 inset in Figure 4-6).

Several channel improvement projects have also been conducted in an effort to improve bank stability and increase conveyance. This work, performed in accordance with a Section 404 permit from the USACE (see Table 1-1), resulted in impacts to 3,900 lineal feet (single shoreline) of lower Creve Coeur Creek on six separate occasions (1986, 1987, 1990, 1992, 1994, 1996), and 5,200 lineal feet of Louiselle Creek for channel maintenance in 1997.

Under normal conditions (i.e., non-flood), the 500-year levee has no interaction with the Missouri River as flows are generally confined to the area within the river banks. Consequently, under such conditions, the levee exerts no effects on river hydrology, water quality, or its biological resources.

The construction of the 500-year levee by the HBLD has had the primary effect of eliminating (or further reducing) the potential for Missouri River flooding of the study area. Under high flood conditions (20- to 40-year plus frequency), the prior levee has the effect of confining flood water to the main channel and unprotected floodplain areas north of the river. The effects of this has been to alter hydrologic parameters (velocity, flood stage), diminish the water quality improvement function of the Howard Bend floodplain (e.g., reduced turbidity due to the settling of materials within the floodplain), and in providing aquatic species habitat (e.g., fish foraging and spawning). It should be noted that flooding of the Howard Bend floodplain from Missouri high-water events has been limited – having occurred four times since the 1940s. While such events have been infrequent, the recent event in 1993 had the effect of inundating the entire floodplain.

Another effect of the construction of the 500-year levee consisted of the creation of several surface water bodies (see Section 3.8.1.2). For example as depicted in Figure 3-7, two large open water bodies (one near the Missouri American Water Company plant totaling 20.9 acres (Reising borrow site), and one outside of the levee near River Valley Drive totaling 49.0 acres (Moore site) were formed as a result of the development of borrow sites. Other borrow sites that exhibit open water under various river conditions include the old golf course site and the Stolte borrow site. These areas have been formed by infiltration of groundwater, runoff, river seepage and river flooding and vary in water depth.

4.8.1.3 Future Actions

Potential effects of reasonably foreseeable future actions on surface water resources within the study area are summarized in Table 4-11 and are discussed below for each action.

Table 4-11. Summary of Impacts to Surface Water Resources Associated with Past, Present and Reasonably Foreseeable Future Actions

Action	Summary of Impact
Primary Action	
Alternative 1: Case by Case (No Action)	Continued protection of surface waters through existing USACE Regulatory Program Potential for lower level of control of non-point source pollution due to minimal buffer requirements Potential for mitigation out of study area
Alternative 2: SAMP	Continued protection of surface waters through existing USACE Regulatory Program Increased protection of surface waters due to expanded buffer requirements Requirement for mitigation within the study area
Past Actions	3,900 lineal feet of streams improved through bank stabilization projects 5,200 lineal feet of Louiselle Creek affected by channel maintenance activities Roadway bridging of upper Creve Coeur Creek and Missouri River (Page Avenue Extension) Reduced turbidity and sedimentation in Creve Coeur Lake due to construction of Page Avenue sedimentation basin Channelization of upper Creve Coeur Creek to connect to sedimentation basin
Present Actions	Roadway bridging of lower Creve Coeur Creek and Fee Creek (MHE) Creation of open water bodies in two locations totaling 69.9 acres of new open water habitat
Reasonably Foreseeable Future Actions	
1. Flank Levee System	
Alternative A	Channel alternation of up to 12,000 feet along Lower Creve Coeur and Fee creeks
Alternative B	Channel alternation of up to 12,000 feet along Lower Creve Coeur and Fee Fee creeks. Portions of lower Creve Coeur and Fee Fee creeks subject to Missouri River flooding
2. MHE Extension	
Options 1-5	Roadway bridging of upper Creve Coeur Creek
3. Baxter Road Extension	
Options 1-2	Roadway bridging of Bonhomme Creek Culverted Crossing of Intermittent Creek
4. Hog Hollow Road Relocation	No impact
5. MSD Plant Expansion	No impact
6. Land Use Plan Development	
Scenario 1: Interim Condition	Potential for erosion and sedimentation within surface water resources during construction phase Potential for increased pollutant loading due to stormwater runoff from paved surfaces
Scenario 2: Ultimate Condition	Potential for erosion and sedimentation within surface water resources during construction phase Potential for increased pollutant loading due to stormwater runoff from paved surfaces
7. Terra Vista Estates	No Impact
8. Mill Ridge Villas	No Impact
9. Creve Coeur Lake Dredging	Increased water depth, improved water quality of Creve Coeur Lake

Flank Levee System

The flank levee system is a major action that will have a significant effect on surface water resources. Direct impacts to surface water resources will primarily occur in conjunction with the excavation of lands immediately adjacent to the streams contained within the flank levee system (i.e., Fee Fee Creek, lower Creve Coeur Creek, Louiselle Creek) and in conjunction with the construction of the pump station and gate structure. These activities will result in excavation and/or filling of streams for each flank levee alternative in order to construct appropriate overflow and diversion structures and suitable detention areas. In its constructed condition, the flank levee system under Alternative B will include a central channel surrounded by a maintained, vegetated area (i.e., grassed conveyance area). By comparison, Alternative A may incorporate management measures that will allow for redevelopment of some natural habitats within the flank levee system provided excess silt is not trapped. For both alternatives, the existing channel will be subject to a high degree of modification (up to 12,000 lineal feet of Lower Creve Coeur and Fee Fee creeks).

One notable characteristic of flank levee Alternative B (gated discharge at Creve Coeur/Fee Fee creeks junction) is that the stream system within the flank system may be more accessible to aquatic biota from the river. This will increase connectivity between the aquatic ecosystems of the river environment and those of upper Fee Fee Creek, thereby enhancing overall aquatic ecosystem function.

By comparison, the absence of a future flank levee system (see Scenario 1 under Future Land Use Development, below) would not result in impacts to the stream channel and riparian corridor along lower Creve Coeur and Fee Fee creeks.

MHE Extension

The extension of the MHE south to Olive Boulevard will entail one or more crossings of Creve Coeur Creek, depending on the alternative selected. Crossing of the creek in these locations, however, is anticipated to be accomplished by bridging, since Creve Coeur Creek has a designated floodway in this location. As a result, impacts to surface water resources are expected to be minimized, since bridging will likely entail little or no instream construction activities.

Baxter Road Extension/Hog Hollow Road Relocation

The Baxter Road Extension is an action that will necessitate the crossing of Bonhomme Creek and a small intermittent tributary. The crossing of Bonhomme Creek would likely be constructed by bridging, whereas the intermittent tributary would be crossed on fill using a culvert. Potential impacts to surface water resources with both crossings are expected to be minor and primarily related to the construction phase.

Future Land Use Development

The build out of unconstrained lands in accordance with the City of Maryland Heights' Future Land Use Plan would entail a large scale alteration of land cover within the study area as was discussed in Section 4.6.2.1. Potential short-term effects of this action include local site disturbance and an increased potential for erosion and sedimentation within receiving surface water resources. If all areas identified within Figure 2-11 are converted to developed areas, a total of 16.7 acres associated with the newly formed borrow lake near the Missouri American Water Company plant are vulnerable for future development. In all likelihood, however, this open water area is likely to be left intact and incorporated into a local stormwater detention system for individual site developments in this area. Increased development, however, will likely also result in an increase in runoff rates and increased pollutant loading (oil, grease, metals, etc.) associated with stormwater runoff from paved surfaces.

Land Development Scenarios 1 and 2 are quite different with regard to the intrinsic impact to surface water resources of lower Creve Coeur, Fee Fee, and Louiselle creeks. In particular, Scenario 1 assumes the absence of a flank levee system which would result in reduced impacts to creek channels and riparian corridors.

Creve Coeur Lake Dredging

Dredging of Creve Coeur Lake is planned to be conducted by hydraulic dredging. Slurry carrying the dredged materials will be deposited in each of two basins designed to retain the sediments (see Figure 2-9). The resultant effect of this dredging activity will be to remove accumulated sediments from Creve Coeur Lake, thereby increasing average depth within the lake. Increased water depth, coupled with the effects of the upstream sedimentation basin will likely improve water clarity as a result of increased light penetration, increase primary productivity, and improve the quality and productivity of the aquatic ecosystem.

4.8.1.4 Regulatory Action

The intent of the USACE's regulatory program is to protect surface water resources. With regard to the No Action alternative (Case-by-Case Permitting), projects will be permitted on an individual basis under the guidelines of the current regulatory program (see Section 2.1). As with the SAMP alternative, direct impacts to surface water under the No Action alternative will be mitigated under the current policies requiring in-kind replacement. However, requirements for vegetated buffers around receiving surface water resources will be minimal. Consequently, the increase in pollutant loading into surface water systems is likely to go unchecked. By comparison, the SAMP alternative will require stream mitigation to occur within the study area and a more extensive and comprehensive buffer system that will afford a greater degree of water quality protection than that provided by the No Action alternative.

4.8.2 Groundwater Resources

As stated in Section 3.8.2, groundwater is present within the study area in the alluvial (sand/gravel) and bedrock (limestone) aquifers. The bedrock aquifer is unlikely to be vulnerable to project effects due to its depth below the ground surface (typically exceeds 100 feet) and the fact that the primary source of groundwater recharge originates from upland areas. In contrast, the alluvial aquifer is considered more susceptible to impacts, due to its proximity to the surface (less than 10 feet in some areas and seasons) and higher permeability (ability to transport water).

4.8.2.1 Historical Overview

As stated in Section 4.6.2.1, the study area has historically been subject to large scale land clearing and draining for agricultural uses, urban development, and levee construction. The construction of wing dams has constricted the Missouri River and decreased the area of open water. In addition, the urban development of the surrounding uplands has increased the volume of surface water runoff that currently flows across the study area. In short, the surface water hydrology (water quantity and quality) within the study area has been significantly modified by man. One resultant effect of this historical change in use has been to increase the rate of surface water runoff (from agricultural lands) and decrease the degree of groundwater recharge (compared to pre-settlement conditions).

4.8.2.2 Past and Present Actions

The alluvial aquifer, however, typically receives a significant amount of recharge water from the Missouri River, along with lesser amounts of direct infiltration of rainwater and recharge from lakes and streams. As a result, the groundwater originating from the Missouri River has not been significantly impacted by either past or present actions. The frequency of interior flooding will decrease as a result of the construction of the 500-year levee. However, this will not significantly alter the typical (non-flood stage) alluvial aquifer groundwater conditions.

4.8.2.3 Future Actions

With respect to future actions, the completion of the flank levee system (either Alternative A or B) will reduce the extent of interior surface water flooding but, like the 500-year levee, is not expected to significantly alter the typical (non-flood stage) alluvial aquifer groundwater conditions. Other individual future actions such as the MHE Extension, Baxter Road Extension, MSD Plant Expansion, Terra Vista Estates, Mill Ridge Villas, Creve Coeur Lake Dredging, and Hog Hollow Road Relocation, are not expected to have a significant impact to the alluvial aquifer. Although, these actions will result in changes to groundwater recharge/discharge functions and groundwater flow patterns, these impacts are expected to be localized and not affect the overall utilization of the alluvial aquifer.

Development of unconstrained lands in accordance with the City of Maryland Heights' Future Land Use Plan could result in the conversion of about 2,100 acres of land (primarily agricultural, developed and grassland cover types). The extent to which these cover types will be impacted, however, will depend on the particular development (refer to Section 4.6.2.1). In general, however, this development will result in a significant increase in impervious surface area (buildings/parking lots, etc.), a corresponding increase in surface water runoff, and a decrease in groundwater recharge. Therefore, there may be some reduction in the quantity of available groundwater in the alluvial aquifer as a result of future development in the study area. The extent of these impacts will depend on the proximity to the Missouri River and the amount of local groundwater recharge.

4.8.2.4 Regulatory Action

Neither the No Action (Case-by-Case Permitting) nor SAMP alternatives will have a significant impact on groundwater resources. However, the SAMP alternative will provide a greater degree of wetland protection and will ensure that wetland mitigation will be conducted within the study area. As a result, the SAMP will provide a somewhat greater degree of protection of groundwater recharge areas (e.g., wetlands).

4.8.3 Floodplains

In accordance with Executive Order 11988, Floodplain Management, Federal agencies are required to assess affects of their actions on floodplains. Because of the very nature and setting of this project, floodplains and floodplain use are central issues. Consequently, it is important to establish an historical context of flooding and flood control within the Howard Bend study area.

4.8.3.1 Historical Overview

As is discussed in Section 4.6.2.1, the Howard Bend area has a long history of agricultural use. Aerial photos from 1928 reveal that vast areas of the floodplain had been cleared and were undergoing active cultivation (see Figure 4-3). The absence of flood control measures at this time left these lands vulnerable to frequent inundation by flood events from the Missouri River. In order to minimize losses from such events, the construction of earthen levees was initiated in 1935. Levees were expanded and strengthened in the years following World War II as mechanized equipment became more available. Major flood events that resulted in the failure or overtopping of these levees occurred in 1935, 1941, 1944, 1947, 1951, 1986, 1993, and 1995 (Stemme, personal communication). Flooding in 1951 and 1993 were the most severe, resulting in water depths of 8 to 10 feet across the floodplain. The HBLD was formed in response to the 1993 flood event and serves as a local agency that is responsible for interior drainage and flood control.

4.8.3.2 Past Actions

Impacts of past actions on floodplains have been primarily limited to the effects of the construction of the 500-year Riverport levee and the 100-year flood protection berm surrounding

the Harrah's Casino complex. Prior to the construction of these developments, the entire Howard Bend study area was mapped as 100-year floodplain (Zone A on FIRMs) by the FEMA. Collectively, these projects have resulted in the loss of approximately 638 acres of floodplain (Table 4-12). Other past actions have resulted in the placement of fill within the floodplain (e.g., Page Avenue Extension, Creve Coeur Airport expansion, Sportport) but these projects have been constructed at elevations below the 100-year flood level and have generally been required to provide compensatory on-site stormwater detention. In the case of the Page Avenue Extension, the selected alignment was to result in the placement of fill within an estimated 141 acres of floodplain (Booker Associates, 1992). However, as it was originally evaluated in the Final EIS, this encroachment resulted in the construction of the Page Avenue Extension above the 100-year flood level. As constructed, however, Page Avenue was completed at an elevation below the 100-year elevation (50-year flood level), resulting in a somewhat lower floodplain encroachment. This action, however has resulted in the placement of fill within approximately 210 acres of floodplain and has increased the accessibility of the study area. This increased access has resulted in further pressure (economic and political) to provide additional floodplain protection and additional land development.

Table 4-12. Summary of Impacts to Floodplains Associated with Past, Present and Reasonably Foreseeable Future Actions

Action	Acres Impact
Primary Action	
Alternative 1: Case by Case (No Action)	No impact
Alternative 2: SAMP	No impact
Past Actions	638 acres (direct and indirect); 210 acres of additional floodplain encroachment due to Page Avenue Extension fill placement
Present Actions*	4,168 of area designated as non-floodplain (indirect); 126 acres of additional floodplain encroachment due to MHE fill placement
Subtotal	4,806 acres removed from floodplain of Missouri River
Reasonably Foreseeable Future Actions	
1. Flank Levee System	
Alternative A	71.7 filled; 358.7 additional acres removed from floodplain designation (indirect)
Alternative B	116.2 filled; 360.4 additional acres removed from floodplain designation (indirect)
2. MHE Extension	
Options 1-5	2.4-6.6**
3. Baxter Road Extension	
Options 1-2	1.4-3.7
4. Hog Hollow Road Relocation	0.0
5. MSD Plant Expansion	6.6
6. Land Use Plan Development	
Scenario 1: Interim Condition	232.7†, slow rate of conversion
Scenario 2: Ultimate Condition	232.7†, more rapid rate of conversion
7. Terra Vista Estates	4.8**
8. Mill Ridge Villas	23.5 filled; increased flood storage**
9. Creve Coeur Lake Dredging	Increased flood storage within Creve Coeur Lake
Subtotal	343.1-394.1 (direct) 358.7-360.4 (indirect)
Total	5,507.8-5,560.5 (direct and indirect)

* Does not include the alignment of the 500-year levee itself.
† Rate and extent of conversion will be dependant upon the rate of development and will be constrained by additional requirements for on-site detention and stormwater control.
** Reflects FEMA FIRM mapping.

4.8.3.3 Present Actions

The increased flood protection by the 500-year HBLD primary levee has resulted in the issuance of a CLOMR that effectively revises the limits of the 100-year floodplain in the Howard Bend study area (see Section 3.8 and Figure 3-8). As is presented in Section 1.2, this action has entailed the design and construction of a levee substantially on the same alignment of the existing levee. Additionally, it has actually reduced floodway encroachment by relocating a segment of the pre-existing levee to an area outside the FEMA mapped floodway.

Direct impacts of this action have caused a significant change in the amount of FEMA floodplain within the study area including the re-designation of approximately 4,168 acres as non-floodplain. Other direct effects include alteration of hydrology, water quality, and aquatic biological functions of the river during extreme flood events (see Section 4.8.1.2). The 500-year primary levee provides for protection from flooding by the Missouri River, but does not alleviate interior flooding from streams in the study area in response to local storm events. Consequently, the 500-year levee does not remove the 100-year floodplain designation (Zone A) from the entire study area.

In general, the Missouri River floods from bluff to bluff during flood events greater than the 100-year frequency, except for the levee protected areas of Monarch-Chesterfield, Howard Bend, and Riverport. During the feasibility study for the Monarch-Chesterfield Levee Project (raise the existing levee to a 500-year levee), the USACE conducted a HEC-2 model that utilized hydraulic and hydrologic data from current or proposed projects in the study area. These other projects included the Page Avenue Extension, MHE, Howard Bend Levee raise to 500-year, St. Charles L-15 Levee, and the Hazelwood Levee raise. Using these current and future impacts to the floodplain, and updated hydrographic surveys, revised as-built bridge and road plans, and calibration to the 1993 and 1995 flood events, the HEC-2 data set showed that for the 100-year and 500-year project for the Monarch-Chesterfield Levee, the maximum increase in Missouri River water surface elevations at river mile 46.5 would be 0.2 and 0.8 feet, respectively.

Therefore, the cumulative impacts of increased levee encroachments in the Missouri River's floodplain for a 100-year return (1 percent chance) or higher would be 1 foot or less, in accordance with state guidelines. This analysis assumed that the State of Missouri and National Flood Insurance Program is being adhered to by the State of Missouri, and the communities along the Missouri River are adhering to the guidelines of the National Flood Insurance Program. All future structures, levees, buildings, roads, and bridges are assumed to follow the guidelines for floodplain development. The cumulative impacts for the 500-year flood (0.2 percent chance) are not defined by the National Flood Insurance Program.

Other present actions have required the placement of fill within floodplain areas. In particular, the MHE extension to River Valley Drive is being constructed at an elevation above the 100-year flood level of Creve Coeur and Fee Fee creeks. Compensatory storage to offset the effects of this action, however, are being provided by a series of expanded ditches along the length of the new roadway embankment.

Alteration of the floodplain of the Missouri River as reflected by the CLOMR will also have an effect on the mapped extent of the floodplain along upper Creve Coeur Creek, as this area had been influenced by backwater from the Missouri River. The actual nature and extent of the potential mapping changes are not known at this time, as this area was excluded from the area of analysis for the CLOMR. A revision of the FEMA FIRM would need to be made as a result of a Flood Study of upper Creve Coeur Creek. Therefore, for the purposes of this EIS, the current

FEMA 100-year floodplain was used to evaluate the potential effects of future actions on floodplains.

4.8.3.4 Future Actions

Table 4-12 summarizes the potential affects of each future action on the floodplains identified in Figure 3-8. In general, the effects of each of these individual actions are relatively minor. For example, the Baxter Road Extension will entail encroachment on up to 3.7 acres of floodplain of the Missouri River, Terra Vista Estates and Mill Ridge Villas will encroach upon 4.8 acres and 23.5 acres of the floodplain of Creve Coeur Creek, respectively; and the anticipated expansion of the MSD Missouri River Plant will encroach upon 6.6 acres of interior floodplain along lower Creve Coeur Creek. In the case of the MHE Extension, the potential for floodplain/floodway encroachment may be minimized by each of several alignment location alternatives, and by varying the length of bridge (see Section 2.2.2). In accordance with the requirements of FEMA and St. Louis County, local stormwater detention and/or conveyance will be required for each of these actions.

Several other future actions have the potential to result in significant floodplain encroachment and flood zone alteration. Each of theses actions are discussed below.

4.8.3.5 Future Land Use Development

Future development of the areas identified in Figure 2-11 will occur at a rate that is market driven, and in a manner that is consistent with the City of Maryland Heights' Future Land Use Plan. In total, approximately 233 acres of floodplain could be affected assuming the flank levee system is constructed (i.e., Land Use Scenario 2). Similarly, approximately 233 acres of floodplain could be affected if development is completed in the absence of a flank levee system. It should be noted that development may occur within the 100-year floodplain, but such actions would require FEMA approval and will involve greater effort by the developer to accommodate requirements for flood storage. Each individual project will be responsible for local accommodation of stormwater runoff and storage and conveyance methods, either by ditch or pumping. In the absence of comprehensive planning, the Howard Bend floodplain will be characterized by sporadic storage facilities, inconsistent design of runoff controls, and non-uniform conveyance systems.

Flank Levee System

The Creve Coeur Creek and Fee Fee Creek flank levees were initially constructed in the 1940s and originally had capacity to retain storm events. However, as a result of increased development within the uplands, the volume of runoff has dramatically increased and the storage capacity of these channels has subsequently been exceeded. Each of the flank levee alternatives being considered would have the effect of reducing the extent of the 100-year floodplain (Figures 4-8 and 4-9).

Impacts of each flank levee alternative are summarized in Table 4-12. In terms of actual encroachment, Alternative B results in greater direct impact, as it results in effects to approximately 116.2 acres of floodplain as compared to 71.7 acres with Alternative A. However, in terms of the resultant remaining floodplain extent within the interior of the Howard Bend floodplain, each alternative is nearly identical, resulting in the conversion of approximately 360 additional acres (see Table 4-12). Primary effects of each flank levee alternative are to reduce the extent of designated 100-year floodplain in the vicinity of lower Creve Coeur Creek, Fee Fee Creek, and Louiselle Creek (Figures 4-8 and 4-9). Flood storage within Creve Coeur Lake and Little Creve Coeur Lake is maintained under each alternative. Secondary impacts of each flank levee alternative are to support continued floodplain development and alteration. With the

completion of a flank levee system that includes a central conveyance artery, it is expected that additional isolated portions of floodplain will be converted as stormwater is drained away or pumped from development sites to the central conveyance system (see narrative above).

As the configuration of the interior drainage system becomes more certain, a subsequent CLOMR will be sought which will incorporate the features of interior drainage system. As with prior conditions, this CLOMR will become a LOMR after these features are completed and documented as such to FEMA.

4.8.3.6 Regulatory Actions

Under the Case-by-Case alternative, the floodplain will continue to be divided on a piece-meal basis as individual projects are submitted for Section 404 permitting. Project stormwater detention and conveyance will be provided on a project by project basis with limited advance planning. The USACE does not encourage floodplain development but does not regulate floodplain impacts. The USACE will request reviews and comments from Maryland Heights and FEMA to ensure that floodplain issues are resolved and that stormwater detention is adequate.

By comparison the SAMP is a comprehensive plan developed to provide natural resource protection, provide a practical and predictable process for development, and promote consolidated regional land use and environmental planning. As such the plan should provide a more cohesive policy regarding floodplains and the centralization of flood storage. Under the plan, the stakeholders, of which FEMA is a member, will have an opportunity to provide input into the plan specifics for comprehensive floodplain management. The group can address the concerns identified in Executive Order 11988 Floodplain Management.

4.9 Agricultural Resources

Coordination with the NRCS was conducted throughout the course of the environmental documentation and the project planning process for the purposes of identifying wetlands subject to NRCS jurisdiction. NRCS is also the primary agency responsible for coordination pursuant to the Farmland Protection Policy Act (FPPA). For Federally funded projects potentially affecting prime or unique farmlands, coordination with NRCS requires completion of the Farmland Conversion Impact Rating (Form AD-1006), which specifically evaluates the conversion of prime and unique farmland, and statewide and locally important farmland to nonagricultural uses.

4.9.1 Past, Present, and Reasonably Foreseeable Future Actions

Table 4-13 presents a cumulative impact summary of effects to prime and unique farmlands. Past and present actions have resulted in the permanent loss of approximately 1,485 acres of prime and unique farmlands due primarily to the expansion of the transportation infrastructure within the floodplain, the construction of Riverport and Harrah's Casino complex, and the construction of the 500-year levee by the HBLD.

Potential future projects may ultimately result in the conversion of approximately 2,300 acres of prime and unique farmland. Expanded flood protection with the construction of the flank levee system will likely account for the greatest impact of any single project (120 to 169 acres). Other projects will likely result in considerably less impact (4 to 90 acres per project). Additionally, future development within the study area in accordance with the City of Maryland Heights' Future Land Use Plan will also likely result in small-scale (i.e., less than 100-acres per development) impact to prime and unique farmland. Over an extended period of time, as driven by market forces, development of unconstrained lands within the City of Maryland Heights' various planning districts may result in a total prime and unique farmland conversion of up to

1,938 acres. In the case of the interim condition (i.e., land use Alternative 1), it is expected that somewhat less than 1,938 acres will be converted due to the absence of an interior flood control system.

Table 4-13. Summary of Impacts to Prime and Unique Farmland Associated with Past, Present and Reasonably Foreseeable Future Actions

Action	Acres Impacted
Primary Action	
Alternative 1: Case by Case (No Action)	NA
Alternative 2: SAMP	NA
Past Actions	1,059
Present Actions	426
Subtotal	1,485
Reasonably Foreseeable Future Actions	
1. Flank Levee System	
Alternative A	120.0
Alternative B	169.0
2. MHE Extension	
Options 1-5	17-18
3. Baxter Road Extension	
Options 1-2	30-36
4. Hog Hollow Road Relocation	4
5. MSD Plant Expansion	43
6. Land Use Plan Development	
Scenario 1: Interim Condition	Less than 1,937*
Scenario 2: Ultimate Condition	Up to 1,937
7. Terra Vista Estates	7
8. Mill Ridge Villas	10
9. Creve Coeur Lake Dredging	101.0
Subtotal	2,269-2,325
Total	3,754-3,810

* Rate and extent of conversion will be dependant upon the rate of development and will be constrained by additional requirements for on-site detention and stormwater control.

Prime and unique farmland will however, be preserved within several areas including the CCLMP, and in lands on the riverside of the 500-year levee. In total, approximately 2,348 acres of prime and unique farmland will be preserved within these areas.

4.9.2 Regulatory Action

No direct impact to prime and unique farmland will occur as a result of the selection of either the SAMP or the No Action (Case-by-Case Permitting) regulatory alternative. These policies will result in a permitting process that continues to evaluate prime and unique farmland as one of the many natural environmental and public interest factors subject to consideration in the NEPA decision-making process. Conversion of prime and unique farmland with either alternative will occur as a result of impacts from other parties (private or non-Federal public entities) and will in all likelihood, not be subject to FPPA compliance requirements.

4.10 Special Waste

Within the study area, the facilities which are most likely to have potential environmental liabilities are the Arrowhead Airport, Southard Construction, and West-Continental Auto Parts and Salvage Company. Arrowhead Airport appears to have three unregistered USTs on-site. The Southard Construction site may have contaminants on-site that were the result of asphalt paving materials. West-Continental is spread out over approximately 40 acres and may contain any or all of the constituents found during the investigation at Smith Brothers Auto Salvage. These contaminants include petroleum hydrocarbons, metals, polynuclear aromatic hydrocarbons, solvents, and antifreeze.

4.10.1 Past and Present Actions

Construction of the MHE Extension to River Valley Drive impacted the Smith Brothers Auto Salvage site. A site evaluation was conducted and contaminants [benzo(a)pyrene, benzene, total petroleum hydrocarbons (TPH), PCBs and pentachlorophenol] were present on-site at levels that exceeded action levels. The site was remediated and capped; it is currently awaiting closure status.

4.10.2 Future Actions

Construction of the flank levee system for Creve Coeur, Fee Fee and Louiselle Creeks will impact the Southard Construction Company as well as the West-Continental Auto Parts and Salvage Company. Additionally, the Arrowhead Airport site will be affected by the build-out of the City of Maryland Heights' Draft Land Use Plan.

Prior to construction, any potential developer of these sites will need to comply with all appropriate state and Federal requirements requiring site investigation, characterization of potentially hazardous constituents, and remediation to ensure proper health and safety.

4.10.3 Regulatory Action

There will be no effect on special waste from either the SAMP or the No Action (Case-by-Case Permitting) alternative. It is likely that a Phase I Site Assessment in accordance with ASTM Standards will be performed in advance of any proposed development within the study area. Prior to development of any contaminated site, remediation and compliance with all applicable state and Federal laws and regulations are necessary for the issuance of a Section 404 permit by the USACE.

4.11 Visual Resources

An assessment of the visual and aesthetic impacts are based upon the anticipated potential build out of land use in accordance with the City of Maryland Heights' Future Land Use Plan. The plan identifies all potential areas and types of development that may occur in accordance with the Future Land Use Plan. Additionally, the plan also identifies areas in which future development is limited. The analysis of visual impact also includes a consideration of future roadway improvements, storm water conveyance modifications associated with the flank levee systems, future CCLMP improvements, and the Missouri River Treatment Plant expansion. Improvements or modifications in land use in the portions of the study area associated with the City of Chesterfield are predominantly within the lower Creve Coeur Creek area.

Several areas are designated as visually sensitive resources and an assessment of both direct and indirect visual impacts must be presented.

The potential future land use and development build out that may occur and the planned roadway and storm water conveyance systems that will occur over time will significantly alter the visual character of the Howard Bend study area. Visual impacts will be presented for by past/present (1985 to present) as well as reasonably foreseeable future actions (i.e., those actions that are reasonably foreseeable given their adoption into the City of Maryland Heights or City of Chesterfield long range plans and/or their preliminary planning/engineering or commitment to funding).

The visual units were developed based upon general views associated with an area or the visual uniqueness of a specific area. Many of the units (viewsheds) overlap with the abutting unit, but for purpose of definition they have been divided by a significant landscape feature which may or may not create a complete visual barrier to the next area.

The visual units/viewsheds as defined for the study area are as follows:

- Riverport/Harrah's Casino complex development area including Earth City Expressway;
- Creve Coeur airport/MSD area;
- Creve Coeur Mill Road/MHE;
- Creve Coeur Lake area;
- River Valley/Page Avenue Mitigation lands area;
- Upper Creve Coeur Creek Valley area;
- Bonhomme Creek area; and
- Missouri River viewshed.

Table 4-14 summarizes visual impacts by past, present, and reasonably foreseeable actions. An assessment of visual impacts for each foreseeable action and its associated options is also provided for clarification and overall degree of potential impact.

Regulatory Action

There will be no significant effect of the No Action alternative. The SAMP alternative will, however, establish distinct buffers to sensitive natural areas which can reduce modifications of the visual landscape in certain specific areas.

4.12 Summary of Analysis of the Regulatory Alternatives

Each of the preceding sections have assessed the potential consequences of the regulatory alternatives under consideration, as well as the cumulative impacts of each of the past, present, and reasonably foreseeable future actions considered in this EIS. For each resource, this analysis consisted of the establishment of historical trends and the assessment of future impacts. Decisions about the future USACE Regulatory Program, however, must not be considered for each resource independently, but should be based on a fully integrated understanding of the future of the Howard Bend floodplain (in consideration of its existing condition and all reasonably foreseeable future projects). The purpose of this section is to present that integrated overview of the study area and evaluate the effectiveness of each of the regulatory alternatives in consideration of both the existing and future conditions.

Table 4-14. Summary of Impacts to Visual Resources Associated with Past, Present and Reasonably Foreseeable Future Actions

Action	Potentially Affected Viewsheds	Summary of Potential Impacts
Primary Action		
Alternative 1: Case by Case Permitting (No Action)		No distinguishable impact of alternative or visual environment.
Alternative 2: SAMP		SAMP provides buffers to sensitive natural resources which can reduce visual impact or preserve existing visual character of certain areas.
Past Actions	Riverport/Harrah's Casino complex including Earth City Expressway	Predominant visual impacts include conversion of open agricultural lands to commercial development supporting structures 1 to 12 stories in height, associated roadways, parking, levees, lighting, and commercial landscape. Earth City Expressway is widened, and Casino Drive elevated which dramatically changed/altered visual openness/expansiveness of the area including the ground line.
	Creve Coeur Airport/MSD	Minor visual impact included airport expansion of facilities and runways. Predominant visual impact was development of Page Avenue Extension and new Missouri River Bridge crossing of the Page Avenue Extension; significantly modified/severed viewshed to south. Ground line at Page significantly elevated. Sportport lighting highly visible.
	Creve Coeur Mill Road/MHE	Significant changes to visual resources at southern terminus with overpass of Page Avenue Extension.
	Creve Coeur Lake Area	Significant impacts to visual environment at elevated Page Avenue Extension on structure in south end of the lake. Significant mitigation required as part of Page Avenue Extension because of 4(f)/6(f) impacts to CCLMP.
	River Valley/Page Avenue Extension Mitigation lands	Significant visual impacts to north with development of Page Avenue Extension and new Missouri River crossing. Significant mitigation by MODOT of lands east of River Valley and south of CCLMP to offset visual impacts to park. Mitigation has changed visual character of area by creating large expanse of open water (sedimentation basins) and conversion of agricultural fields to old fields.
	Upper Creve Coeur Creek Valley	No significant impact.
	Bonhomme Creek Area	No significant impact.
	Missouri River Viewshed	No significant impact.
Present Actions	Riverport/Harrah's complex including Earth City Expressway	Connection of Howard Bend Levee to Harrah's flood protection berm will modify land form and creates distinct landscape feature south of area viewshed.
	Creve Coeur Airport/MSD Area	Changes in visual character include development of an elevated MHE which severed the open landscape, and new Howard Bend levee which provides a distinct visual line in the landscape and further visually separates open areas from river.
	Creve Coeur Mill Road/MHE	Significant change in visual landscape in four-lane divided and elevated roadway severs open view, changes ground line, and is a dominant landscape feature given its width of right of way, and expanse of concrete. Elevated bridges over Fee Fee and Creve Coeur creeks impact visual continuity of riparian landscape.
	Creve Coeur Lake Area	No direct impacts to lake area visual unit in present actions other than increased vehicular traffic in area via Marine connection to MHE.
	River Valley/Page Avenue Extension Mitigation lands	Impacts include modified height and width of opening for Page Avenue Extension interchange with MHE creating more dominant land form. Howard Bend Levee creates dominant land form and distinct line in landscape separating Missouri River area from open and expansive landscape.
	Missouri River Viewshed	Predominant visual impacts include Howard Bend Levee which creates a distinct ground line and visual demarcation from tree masses abutting river viewshed. Significant visual impact of new tied arch bridge over Missouri River alters overall character of viewshed.
	Other Viewsheds	No significant impact.

Table 4-14. Summary of Impacts to Visual Resources Associated with Past, Present and Reasonably Foreseeable Future Actions

Action	Potentially Affected Viewsheds	Summary of Potential Impacts
Reasonably Foreseeable Future Actions		
1. Flank Levee System		
Alternative A Alternative B	Riverport/Harrah's, Creve Coeur Airport/MSD, and Creve Coeur Mill Rd/MHE	Flank levee construction will create distinct modification to ground line and loss of tree masses abutting Fee Fee and lower Creve Coeur creeks with earthen berm. Flank levees create distinct geometric shape in landscape.
	Other Viewsheds	No significant impact.
2. MHE (Options 1-5)	River Valley/Page Avenue Mitigation Lands	MHE to be located in 660-foot reserved transportation corridor. MHE right of way and four lanes of concrete create distinct visual line and visually severs landscape. Roadway approach berms elevate/modify land form at south end of viewshed. Distinct changes in visual landscape.
	Upper Creve Coeur Creek Valley	Options 1-5 vary in visual impact. Overall significant changes in visual character include four-lane roadway elevated on concrete structure; potential loss of residential/commercial buildings in visual landscape.
	Other Viewsheds	No significant impact.
3. Baxter Road Extension (Options 1-2)	Bonhomme Creek River Valley/Page Mitigation	Visual impact to Bonhomme Creek area by elevated roadway. Creates distinct visual line in landscape. Option 2 extends to MHE corridor; moderate visual impact along base of bluff; utilizes previously impacted corridor (i.e., Paper Street). Potential impact to 4(f)/6(f) mitigation lands with the intersection with reserved corridor; modifies line and character of this area (see Figure 4-1, Transportation Network with Reasonably Foreseeable Actions).
	Other Viewsheds	No significant impact.
4. Hog Hollow Road Relocation	River Valley/Page Avenue Extension	Low visual impact of Hog Hollow Road east of Missouri American Water's Central Plant.
5. MSD Plant Expansion	Creve Coeur Airport/MSD	Additional structures, treatment expansion changes land form and visual character moderately.
	Creve Coeur Mill Road/MHE	Moderate indirect impact; portion of plant expansion visible to viewshed.
6. Land Use Plan Development		
Scenario 1: Interim Condition Scenario 2: Ultimate Condition	Riverport/Harrah's	Continued build out of Riverport/Harrah's will have moderate impact on visual character of area as remaining undeveloped ground is built. Visually denser condition; less space between existing structures.
	Creve Coeur Airport/MSD Creve Coeur Mill Road/MHE Creve Coeur Lake Area River Valley/Page Avenue Mitigation Lands Missouri River Viewshed	Sight lines reduced by buildings of varying height and density. Viewsheds convert from predominant open/expansive views to more urban characterized by vertical elements of structures, ground line modifications, texture and surface of landscape dramatically altered. Open agricultural landscape replaced by architectural features. Creve Coeur Airport/MSD and Creve Coeur Mill Road/MHE character modified by vertical architectural elements, interspersed with open space for stormwater management. Visual character of area is less dense than Option 2. Potential indirect impacts to Creve Coeur Lake area viewshed depending upon height of structures in surrounding environs. Moderate impact to Missouri River viewshed; predominant views to development areas buffered by tree masses and proximity to views from Missouri River.
	Upper Creve Coeur Creek Valley Bonhomme Creek Area	No significant impact.
7. Terra Vista Estates 8. Mill Ridge Villas	Upper Creve Coeur Creek Valley	Moderate visual impact to green space. Tree masses replaced by residential structures; streets, lighting, ground line significantly modified; views shortened.
9. Creve Coeur Lake Dredging	Creve Coeur Lake Area	Impacts associated with loss of existing tree mass.

4.12.1 Integrated Overview of the Howard Bend Study Area

The Howard Bend study area is an expansive area of the Missouri River floodplain that at one time provided a rich mosaic of bottomland forest, wetland, and open water habitats. A long history of agricultural use, however, has resulted in significant and long lasting effects on the function and value of the study area for wildlife (due to land cover alteration) and for flood storage (due to levee construction). In recent years (i.e., since 1985), the Howard Bend floodplain has demonstrated a notable and increasing shift in character as a result of the construction of large-scale developments (i.e., Riverport and Harrah's) and a significant expansion of the transportation infrastructure (e.g., Page Avenue and MHE). These improvements, coupled with a significant increase in flood protection due to the construction of the 500-year primary levee and the adoption of a Future Land Use Plan for the area by the City of Maryland Heights, and the stated intentions of the HBLD to construct an interior flank levee system, have set the floodplain on a course that will entail a continued alteration of its character to that of developed uses. In total, approximately 2,100 acres of additional lands may be subject to future development. Altered environmental conditions as a result of these actions will create a future study area that will be characterized by increased traffic, altered visual landscapes, and increased noise.

In spite of this prevailing trend towards future land development, the Howard Bend study area also entails the integration of land areas dedicated to open space, wildlife habitat, and recreation. CCLMP, coupled with the open lands of the Missouri Riverfront, account for approximately 4,200 acres that will remain as undeveloped wildlife habitat or that will be available for recreational uses. These areas will provide for sustained recreational use, the maintenance of wildlife habitat, and continued wetland support functions. Due to the proximity of these areas to existing and future transportation facilities, these areas will be subject to on-going visual and noise impacts.

4.12.2 Evaluation of the Regulatory Action Alternatives

A synopsis of the relative effects (consequences, including benefits) of each regulatory alternative under consideration are summarized in Table 4-15. In summary, the regulatory actions under consideration represent differences in the policy and process by which potential projects affecting waters of the United States are evaluated for issuance of CWA Section 404 permits (see Section 2.0). Additionally, because the very intent and purpose of Section 404 of the CWA is to regulate waters of the United States, the resources that may be most affected by a change in the program are expectedly those that have some relationship to wetlands, aquatic ecosystems, or water quality. As presented in Table 4-15, these resources include land use, soils, land cover, wildlife, sensitive species, wetlands, surface water resources, and groundwater resources. However, other laws with which the USACE must comply in the administration of its Regulatory Program include the Endangered Species Act, the National Historic Preservation Act, Fish and Wildlife Coordination Act, CAAA, Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), RCRA FPPA, Noise Control Act, and Bald Eagle Protection Act. As such, the USACE Regulatory Program will continue its required consideration of such issues as threatened and endangered species, cultural resources, air quality, noise, special wastes, and prime and unique farmlands. Primary differences in the consequences of each of the regulatory alternatives include the following:

- **Wetland Preservation** – The SAMP alternative expands on the preservation of existing wetlands over that which exists currently. At present, a total of 153 acres of wetlands are preserved with CCLMP and other mitigation lands as compared to a total of 483 acres of wetlands that would be preserved under the SAMP alternative.

- **Comprehensive and Consolidated Mitigation** – Potential unavoidable adverse impacts to waters of the United States will be mitigated under each alternative. However, the SAMP alternative will ensure a more cohesive approach that will ensure that mitigation will take place within the study area (Case-by-Case Permitting has resulted in historical net losses within the study area). Additionally, the establishment of a wetland and stream bank(s) will ensure that the mitigation wetlands and streams are functional and well managed.

- **Water Quality Protection and Enhancement** – The SAMP alternative provides features that further ensure the protection and enhancement of water quality. These measures include the mitigative measures discussed above as well as added requirements for the establishment of vegetation buffers that will reduce erosion and pollutant loading with receiving waters.

  Additionally, the preservation of wetland habitats (under each alternative, but expanded upon by the SAMP) will also provide benefits related to protection of groundwater resources (filtering function of recharge zones).

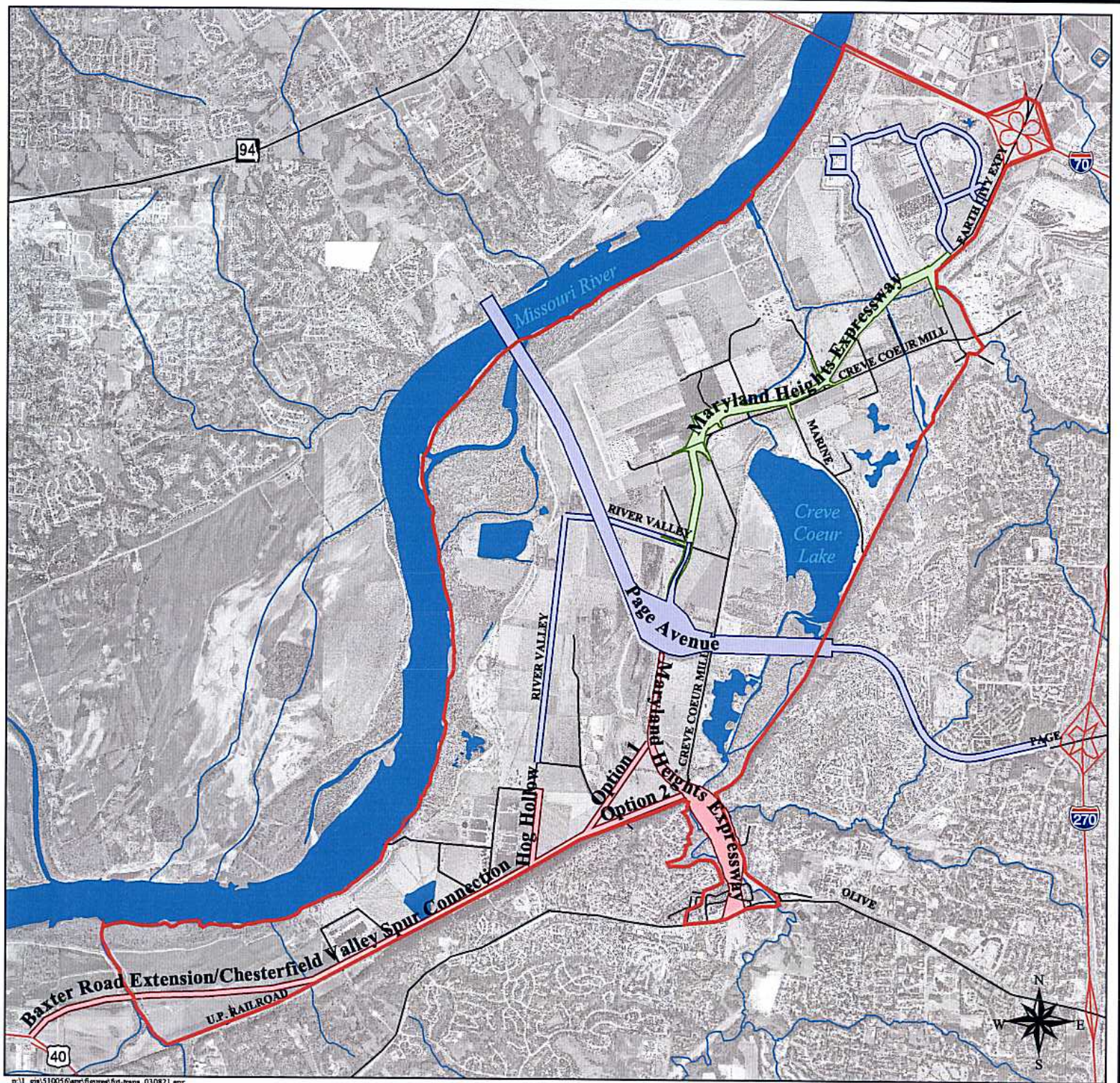
- **Wildlife Habitat Enhancement and Preservation** – The preservation and creation of wetland habitats and vegetative buffers in conjunction with the SAMP will provide added benefit to the wildlife and sensitive species within the study area by a more comprehensive approach to threatened and endangered species coordination, by increasing available habitats and improving habitat connectivity.

Table 4-15. Summary of Impacts of the Regulatory Alternatives

Resource Area	Category	
	Case by Case Permitting (No Action)	SAMP)
Social/Economic Characteristics	No Impact*	No Impact
Land Use	No Impact	Increased degree of habitat preservation Requires dedication of land for wetland bank creation Need for vegetative buffers
4(f)/6(f) Lands	No Impact	No Impact
Cultural Resources	Requires coordination with SHPO for compliance with Section 106 NHPA	Requires coordination with SHPO for compliance with Section 106 NHPA
Air Quality	No Impact	No Impact
Noise	No Impact	No Impact
Mineral Resources/Soils	Requirements for erosion control to be issued as conditions of permit	Requirements for erosion control to be issued as conditions of permit More comprehensive BMPs for erosion control can be utilized More extensive buffer requirements will increase protection of receiving waters

Table 4-15. Summary of Impacts of the Regulatory Alternatives

Resource Area	Category	
	Case by Case Permitting (No Action)	SAMP)
Land Cover	Management of remaining natural resources within CCLMP only; limited or little management of other areas Mitigation for project impacts may be in small isolated areas and out of study area.	Comprehensive management of remaining natural resources using buffers, tree mitigation and wetland mitigation policies Mitigation (wetland, tree) will be required to occur within the study area
Wildlife	Management of remaining natural resources within CCLMP only; limited or little management of other areas	Comprehensive management of remaining natural resources using buffers, tree mitigation and wetland mitigation policies Ensures greater habitat availability and connectivity in the future
Sensitive Species	Management of remaining natural resources within CCLMP only; limited or little management of other areas	Comprehensive management of remaining natural resources using buffers, tree mitigation, and wetland mitigation policies Ensures greater habitat availability and connectivity in the future
Wetlands	Protection of 153 acres of wetlands in CCLMP Isolated project-specific wetland mitigation Potential loss from the Howard Bend ecosystem	Protection of 483 acres of wetlands in CCLMP Comprehensive and consolidated approach to wetland mitigation Wetland mitigation to occur within the Howard Bend ecosystem
Surface Water Resources	Isolated project-specific stream mitigation Potential loss from the Howard Bend ecosystem	Comprehensive and consolidated approach to stream mitigation Stream mitigation to occur within the Howard Bend ecosystem
Ground Water Resources	No Impact	Greater degree of protection of groundwater recharge areas (wetlands)
Floodplains	No Impact	No Impact
Agricultural Resources	No Impact	No Impact
Special Waste	No Impact	No Impact
Visual Environment	Incremental degradation of visual environment due to reduced need for buffers, reduced level of comprehensive land planning.	Improved visual environment due to the use of landscape buffers around sensitive natural resources including protected wetlands, mitigation acres, agricultural fields, and golf courses. Greater opportunity for comprehensive land planning in environmentally sensitive resources.
* "No Effect" relates to the effects of the regulatory alternative rather than other non-Federal actions that may occur in the study area. Such actions in the study area may have an effect on the environment in such a way as to impact or alter the listed resources.		



U.S. Army Corps of Engineers
St. Louis District

Howard Bend Floodplain EIS

Legend

- Past Transportation Project
- Present Transportation Project
- Future Transportation Project

- Study Area
- Road
- Interstate Hwy
- US Hwy
- State Hwy

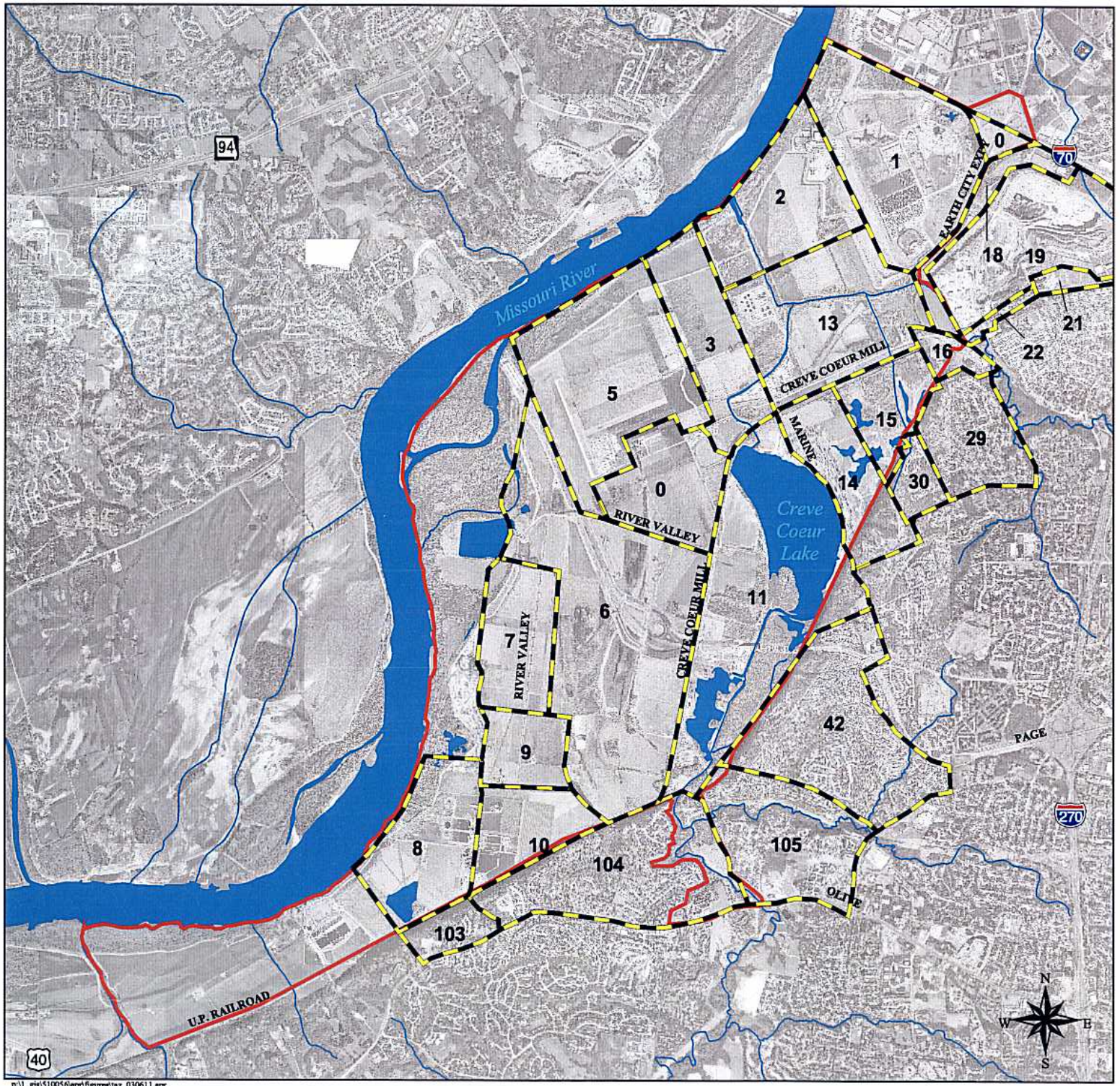
1:60000

0.5 0 0.5 1 Miles

September 16, 2003

Figure 4-1
Transportation Network with
Reasonably Foreseeable Actions

MACTEC, Inc.



U.S. Army Corps of Engineers
St. Louis District

Howard Bend Floodplain EIS

Legend

Transportation Analysis Zone

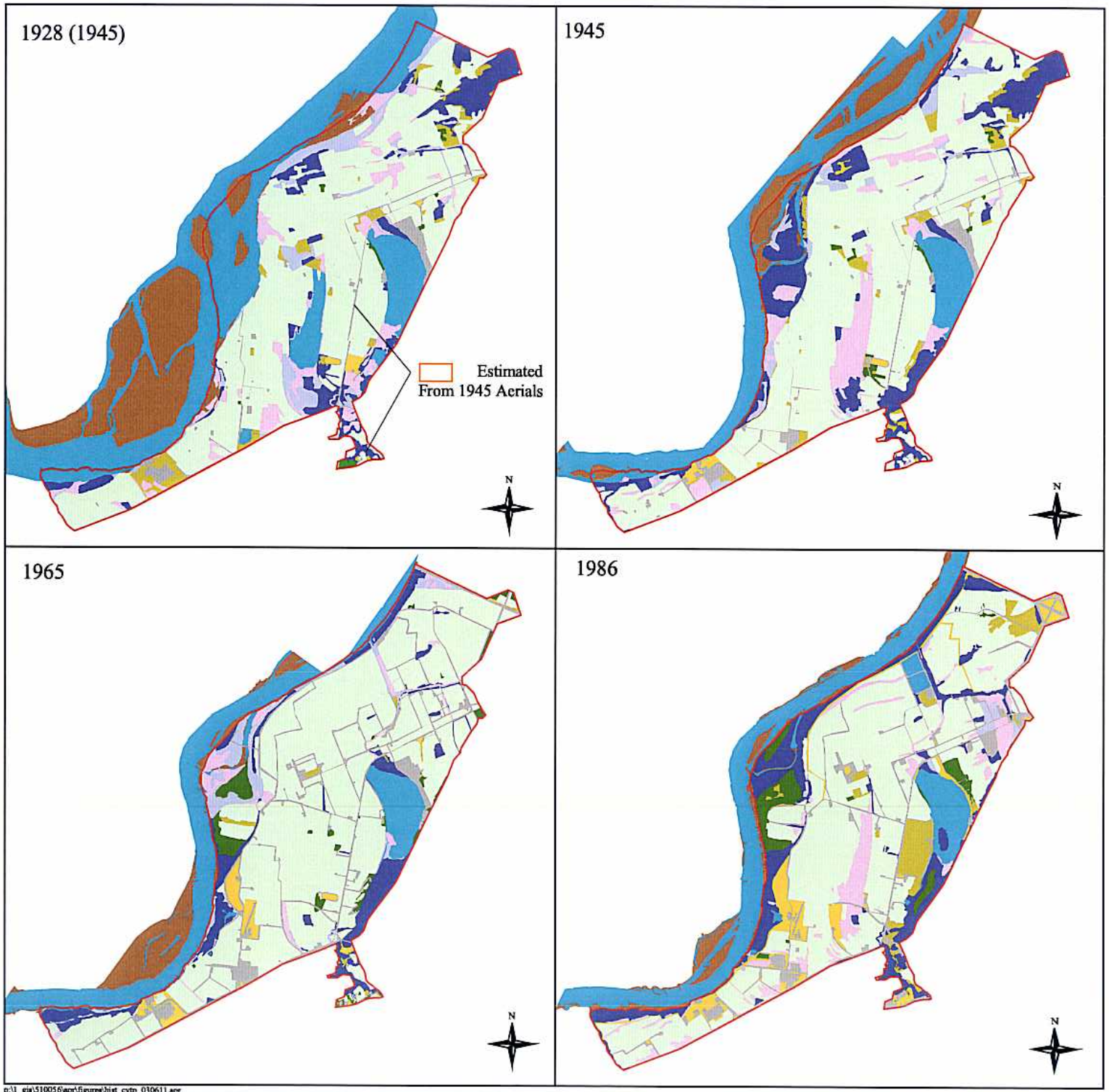
Study Area
Interstate Hwy
US Hwy
State Hwy

1:60000
0.5 0 0.5 1 Miles

June 11, 2003

Figure 4-2
Traffic Analysis Zones

MACTEC, Inc.



U.S. Army Corps of Engineers
St. Louis District

Howard Bend Floodplain EIS

Legend

- Study Area

Cover-Types Within Study Area

- Active Farmfield
- Deciduous Forest
- Grassland
- Mud/Sand
- Oldfield
- Emergent Wetland
- Forested Wetland
- Scrub Shrub Wetland
- Tree Farm
- Urban/Developed
- Water

Cover-Types Outside Study Area

- Water
- Land

1:120000

1 0 1 2 Miles

June 12, 2003

Figure 4-3
Historic Cover Types
within the
Howard Bend Area

MACTEC, Inc.

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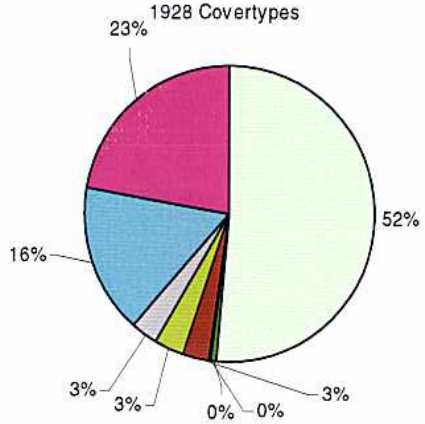

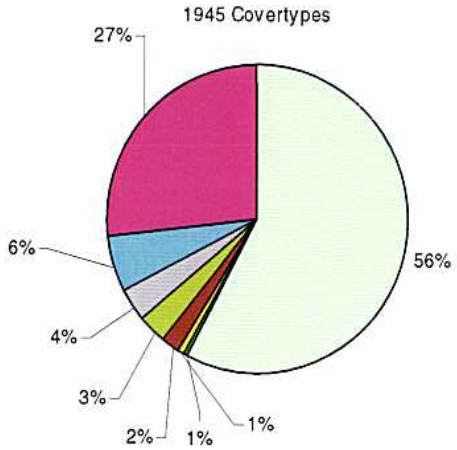

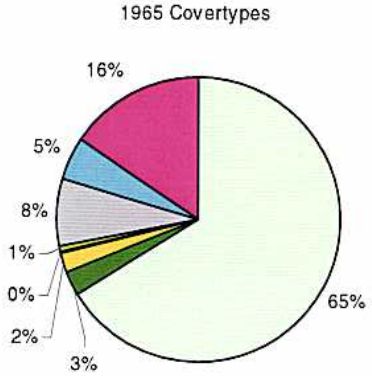

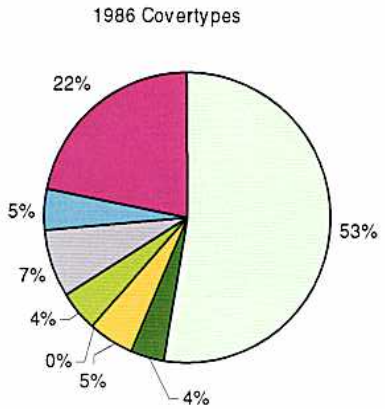

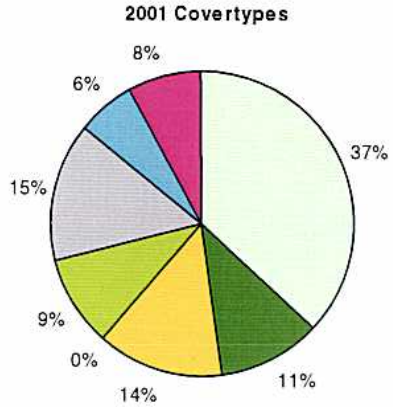

U.S. Army Corps of Engineers
St. Louis District

Howard Bend Floodplain EIS

Legend

- Active Farmland
- Deciduous Forest
- Grassland
- Mud/Sand
- Oldfield
- Urban/Developed
- Water
- Wetland

June 12, 2003

Figure 4-4
Historic Land Cover

MACTEC, Inc.

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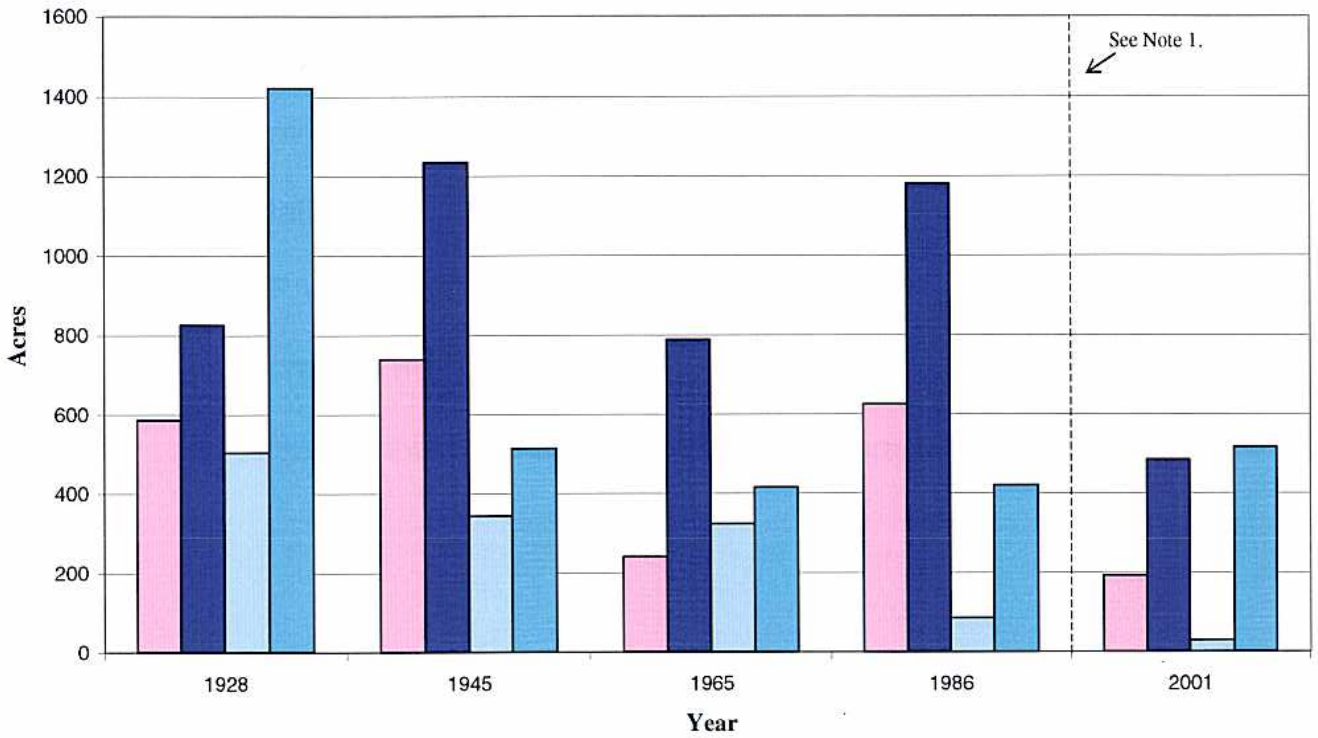
Trend in Wetland Type



Note 1: Wetlands From 1928 - 1986 based on aerial photo interpretation. Wetlands from 2001 based on previously accepted wetland field delineations, NRCS certifications and NRCS slide review.
Note 2: Additional categories for 2001 were combined as follows: Emergent included PEM//PEM/PSS, PEM//PSS, PEM/PSS and Farmed Wetlands. Forested included PFO/PSS and WW. Scrub Shrub included PEM/PSS/PFO.

U.S. Army Corps of Engineers
St. Louis District

Howard Bend Floodplain EIS

Legend

Emergent
Forested
Scrub Shrub
Water

August 20, 2003

Figure 4-5
Trend in Wetland Type

MACTEC, Inc.

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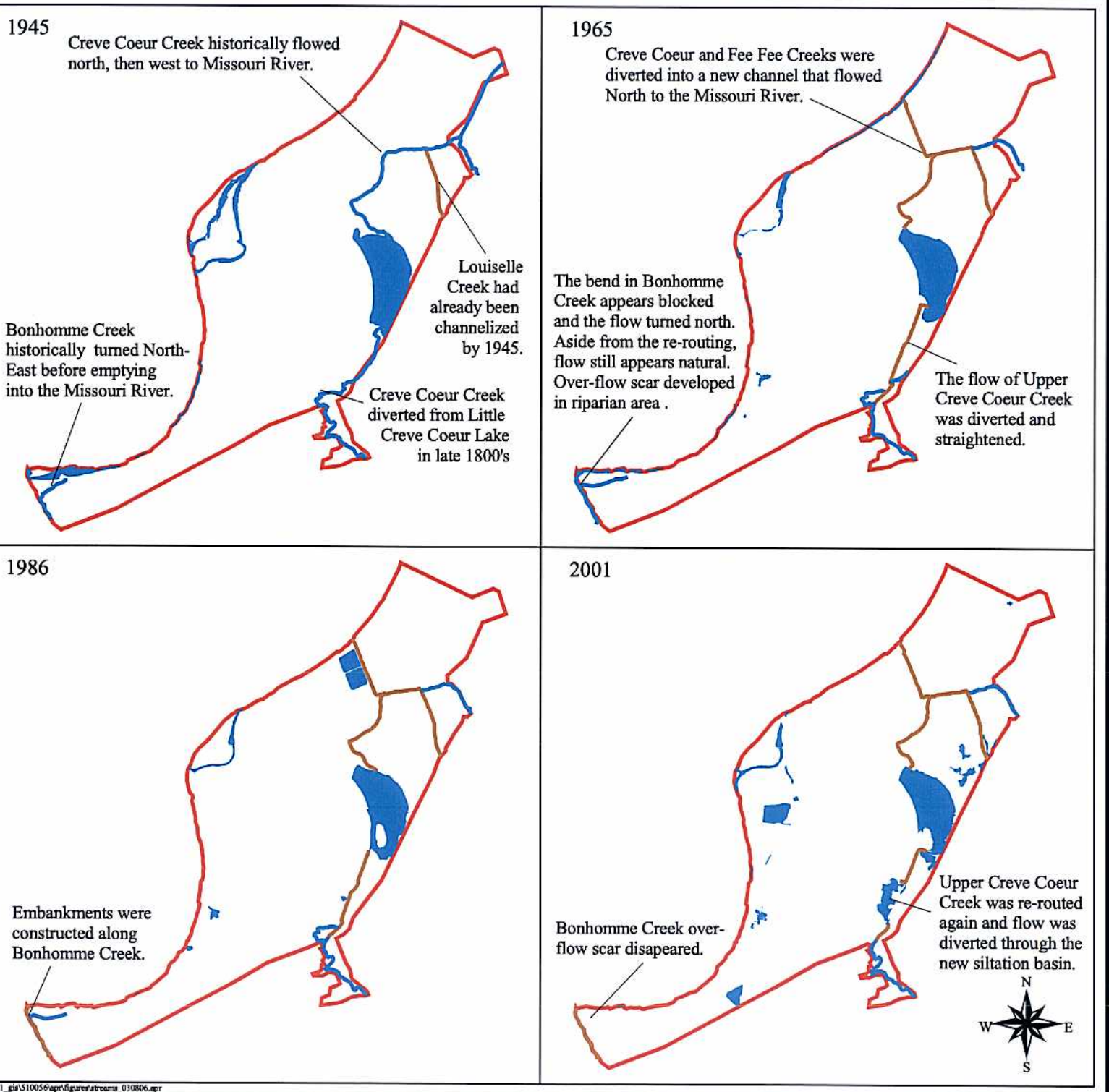

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U.S. Army Corps of Engineers
St. Louis District

Howard Bend Floodplain EIS

Legend

- Natural Stream
- Channelized Stream
- Study Area
- Open Water

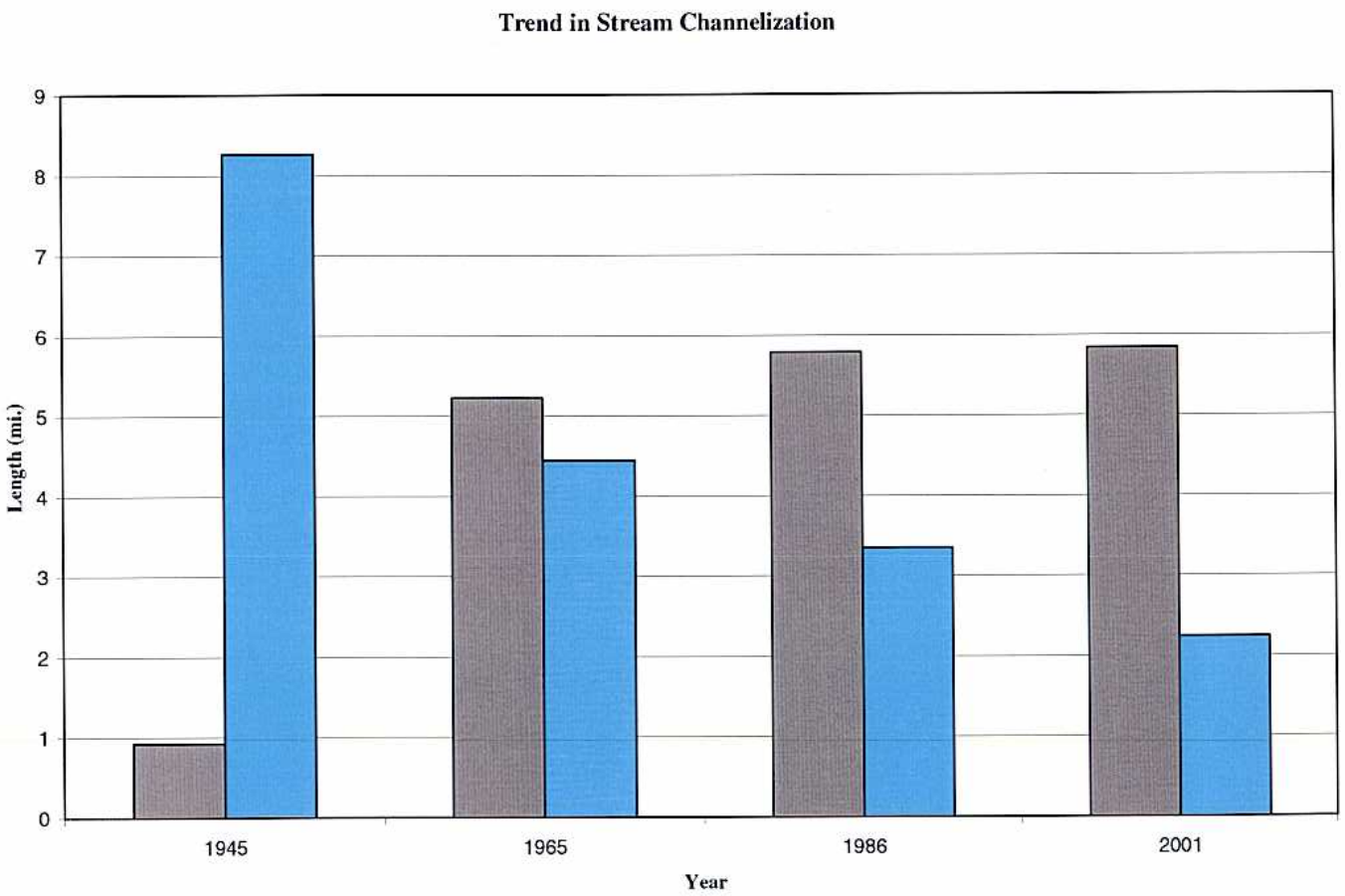
1:120000

1 0 1 2 Miles

September 11, 2003

Figure 4-6
Stream Channelization within the Howard Bend Area

MACTEC, Inc.



p:\l_gis\510056\apr\figures\stream_graph_030612.apr

U.S. Army Corps of Engineers
St. Louis District

Howard Bend Floodplain EIS

Legend

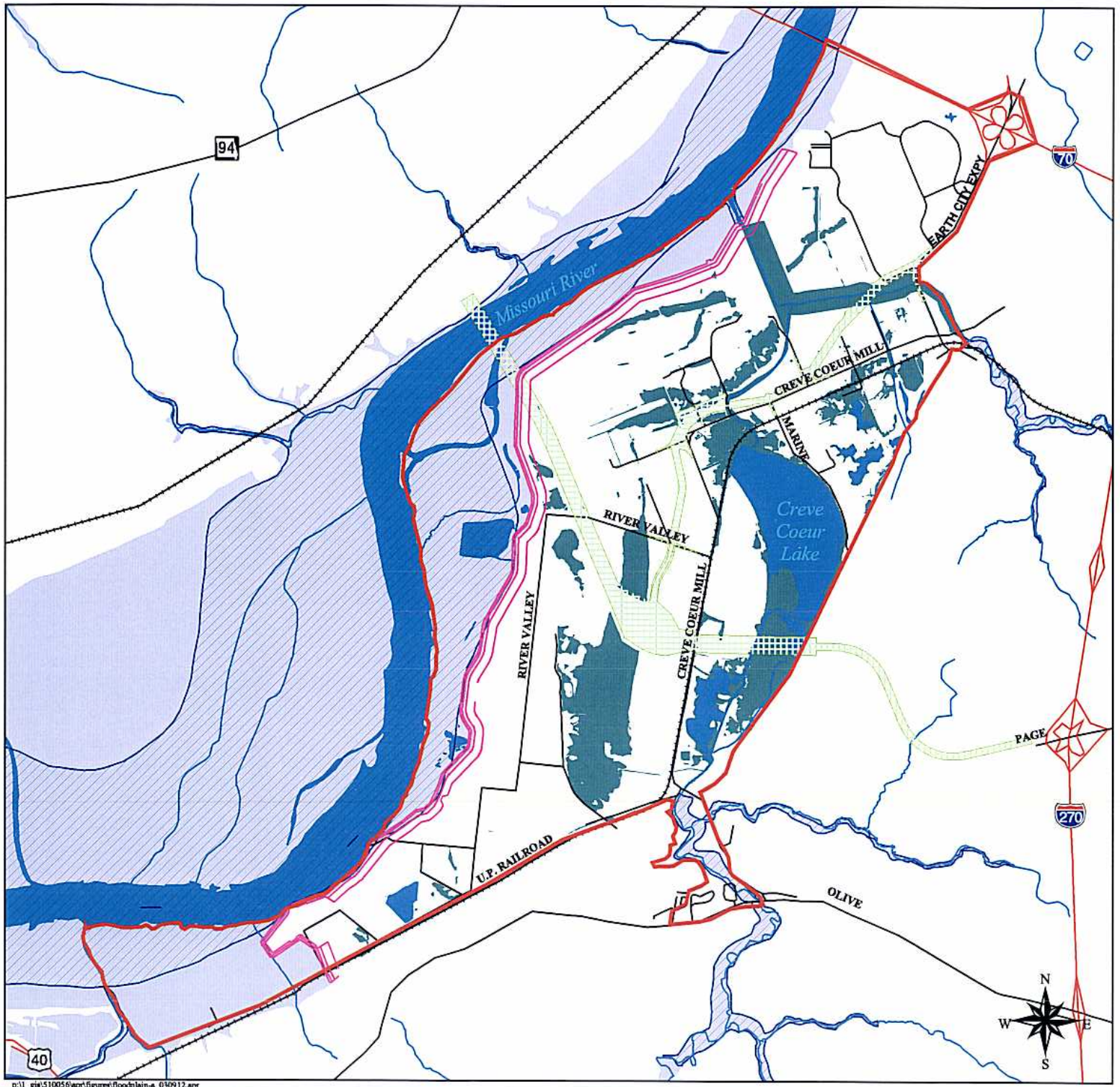
Channel

Natural

June 12, 2003

Figure 4-7
Trend in
Stream Channelization

MACTEC, Inc.



p:\1_gis\510056\apr\figures\floodplain-a_030912.apr

U.S. Army Corps of Engineers
St. Louis District

Howard Bend Floodplain EIS

Legend

- New 500 Year Levee
- Remaining FEMA Floodway
- Flank Alt. A Resultant 1% Probability Floodplain
- Remaining FEMA 1% Probability Floodplain
- Existing ROW

- Study Area
- Interstate Hwy
- US Hwy
- State Hwy
- Road
- Railroad
- Stream
- Water

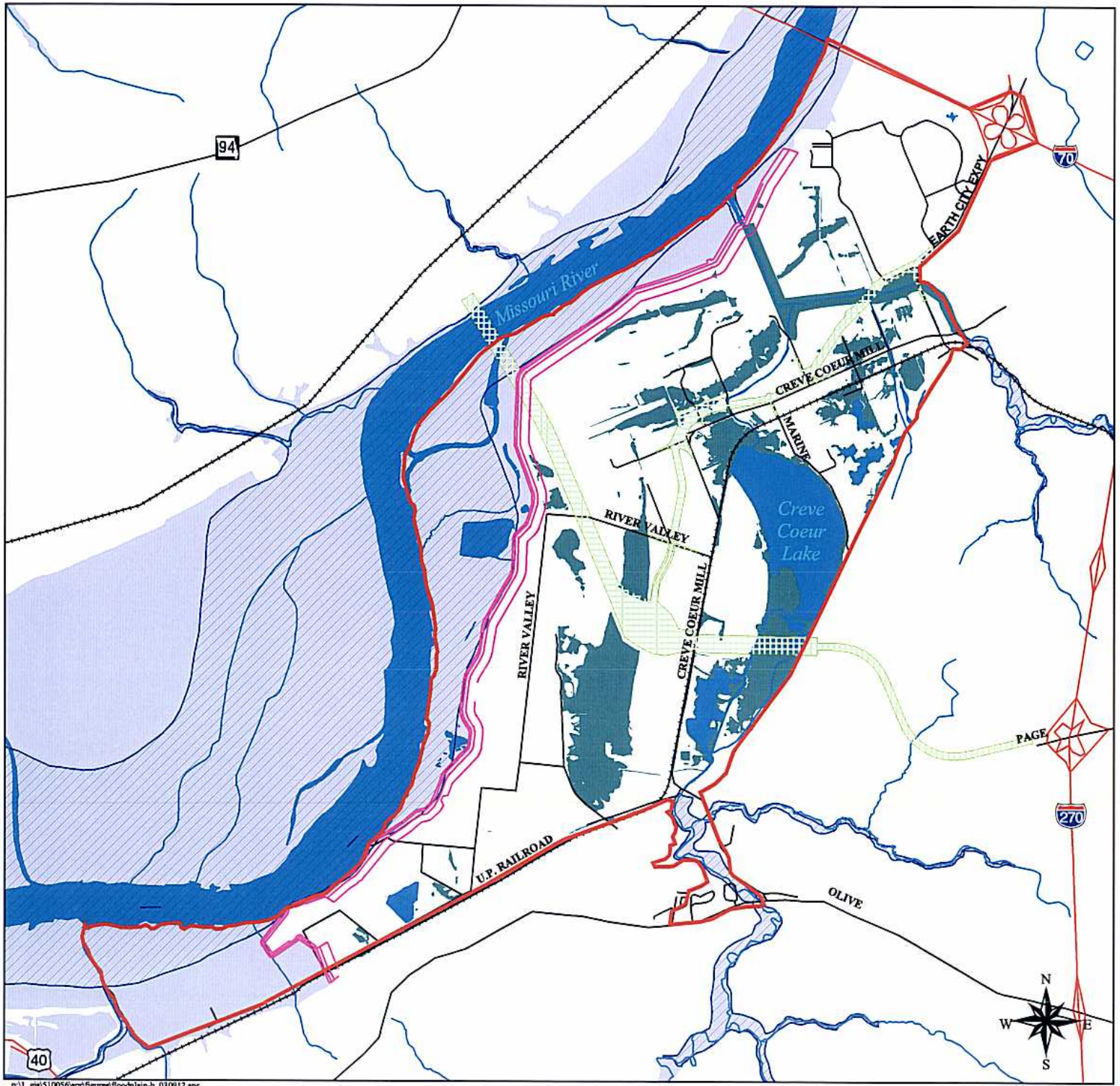
1:60000

0.5 0 0.5 1 Miles

September 12, 2003

Figure 4-8
Howard Bend Area
Floodplain/Floodway with
Future Flank Levee Alternative A

MACTEC, Inc.



U.S. Army Corps of Engineers
St. Louis District

Howard Bend Floodplain EIS

Legend

- New 500 Year Levee
- Remaining FEMA Floodway
- Flank Alt. B Resultant 1% Probability Floodplain
- Remaining FEMA 1% Probability Floodplain
- Existing ROW
- Study Area
- Interstate Hwy
- US Hwy
- State Hwy
- Road
- Railroad
- Stream
- Water

1:60000

0.5 0 0.5 1 Miles

September 12, 2003

Figure 4-9
Howard Bend Area
Floodplain/Floodway with
Future Flank Levee Alternative B

MACTEC, Inc.